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TROPICAL DISEASES BUREAU.

TROPICAL DISEASES BULLETIN.

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APPLIED HYGIENE IN THE TROPICS.

By Colonel W. G. King, C.I.E., I.M.S. (Retired).

REPORTS.

Sierra Leone (1913).*

In Freetown registration of vital statistics is compulsory; elsewhere in the Colony, Hospital and Dispensary Returns only are available. Of 2,811 out-patients, 7·5 per cent. suffered from malaria. There is reason for assuming that, in the majority of these cases, the diagnosis was based upon clinical symptoms. In future, cases thus diagnosed and those microscopically verified will be differentiated.

In Freetown eight cases of sleeping sickness were under observation during the year. "Suspicious cases" were said to have been found in the Koinadugu District. Dr. Rice, in adverting to these, thinks it is open to question whether the disease is more prevalent than when first described in Sierra Leone by Winterbottom in 1803, and by Grattan in 1906.

Twenty-six cases of leprosy were diagnosed. Although nominally segregation is compulsory, it is not enforced; the matter is under consideration by the Government.

As far as statistics available allow the facts to be ascertained, it is estimated that 1·32 per mille of the inhabitants of Freetown suffer from tuberculosis. Of the total of 28,811 out-patients treated in the Hospital and Dispensaries, there were 338 cases of syphilis. Dr. Orpen, in charge of Batkanu, is of opinion that congenital syphilis is comparatively rare.

The average number of European officials resident during 1913 was 131, of whom 22·7 per mille died. Of the total resident officials (244), 5·32 per cent. were invalided. In the case of those who resided on the Hills, "the general health was satisfactory," except in the case of those who proceeded to the Protectorate, where they were exposed to conditions incident to Rest Houses being within native villages.

* Sierra Leone.—Annual Report on the Medical Department, 1913; [Principal Medical Officer, T. E. Rice; Senior Sanitary Officer, R. H. Kennan.] F'cap. 1914 : Printed by Waterlow & Sons, Ltd., London.

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Appended to the Principal Medical Officer's Report are the Annual Reports of individual hospitals and dispensaries. He calls special attention to the fact that some of the latter are in charge of native dispensers, concerning which method he remarks as follows :—

"How much harm is done by the prescribing of remedies by persons who are only qualified to dispense it is difficult to estimate, but it is not to the credit of European medicine that the practice of it should be carried on by unqualified persons ; and I am inclined to think that the interests of the public health would be better served were the centres at which dispensaries have been established visited once a month by a travelling Medical Officer accompanied by a Dispenser."*

The most noteworthy feature of the Hospital Returns is that in the Colonial Hospital, Freetown (Dr. J. Wallace COLLETT) the operations have increased from 44 in 1902 to 365 in 1913. Amongst these were 18 cases of elephantiasis of the scrotum, and one splenectomy.

Dr. A. YOUNG was in charge of the Laboratory of the Colonial Hospital. This has been recently improved in equipment. Dr. BUTLER worked at yellow fever investigation as well as Drs. DALZIEL and JOHNSON of the Yellow Fever Commission. As an hypothesis founded on certain observations, they suggest that "the presence of albumen in suspected yellow fever cases loses its value, and renal casts must straightway be looked for."

Sanitary Section.—Dr. KENNAN shows that the measures to secure the malaria-free condition of Freetown inaugurated in 1899 lack completion ; nevertheless, he is able to record that, during 1913, some progress has been made by the local authorities.

The following mosquito indices were found in Freetown :—"In February seven infected compounds were found out of 250 examined, or 2·8 per cent. ; in May, 14 out of the same number, or 5·6 per cent. ; in August, 10, or 4 per cent. ; and in December (from 15th to 20th) 8, or 3·2 per cent." Dr. BUTLER undertook the duty of ascertaining the malaria endemic and splenic indices in Freetown. The following are the conclusions arrived at by him :—

"Towards the rainy season the apparently healthy children of Freetown, between the ages of three and ten years inclusive, show the presence of 'active' malaria parasites in fifty out of the hundred examined. (2) The percentage of infected children is alike for the children attending the Mohammedan and Christian schools. (3) Of the children showing the presence of malaria parasites approximately 83 per cent. harbour the subtertian form and 16 per cent. the quartan form. (4) Between the hours of 10 a.m. and 12 noon the temperature of children harbouring malaria parasites does not appear to be appreciably raised above that of children not harbouring the parasites. (5) The splenic index was found to be 43 per cent. It is shown in the results that the children harbouring parasites in their peripheral blood have a considerably higher splenic index than those not harbouring parasites."

---

* The writer believes that all who have watched the growth of European methods amongst uneducated tropical races will agree with the opinion that, whatever the system adopted, there should be no pandering to the belief that an unqualified man, provided with stock medicines, can successfully uphold the value of European medical science. No better way could be suggested for impeding civilizing influences at the hands of the white man

The standard thus carefully arrived at will be of great utility in gauging the efficiency of the long-delayed anti-malarial measures at Freetown.

As part of the anti-malaria work Dr. KENNAN shows that the flow of Moore's Brook—an intermittent stream—has been regulated by the cutting of a sufficiently deep channel in the rock, so that "neither adventitious masonry nor concrete supporting work" has been found requisite. In 1903, Dr. W. T. PROUT advised the free use of cement surface drains, as he was much impressed with the results of these adaptations to ten streets. He, however, recommended a complete survey of the town before further progress was made. Dr. KENNAN summarises thus: "The ordnance survey of the town is now in progress; the comprehensive scheme of drainage waits."

The intercepting drain at Brookfields originally advised by Professor SIMPSON is still in process of execution. Dr. KENNAN advocates, as a preliminary to making a concrete invert, exploratory borings so as to ascertain, should water under pressure be struck, whether a sufficient depth to secure interception has been arrived at. He regards the whole work as of much sanitary importance, and one that it is likely will be instructive in its results.

During the year, Dr. W. ALLAN was appointed Acting Medical Officer of Health, Freetown. He has undertaken much hard work in ascertaining the extent to which wells afford breeding places for mosquitoes, and has noted where anopheles and culices, respectively, made their choice.

The provision of a water supply for Freetown is now in progress "by gravitation from streams from the Sugar Loaf Mountains." Dr. W. T. Prout, when Principal Medical Medical Officer, in 1902, expressed the hope that *when* the water supply was an accomplished fact *all* wells in the town would be closed. This advice is supported by the report of the Acting Medical Officer of Health that these form "a fertile source of mosquito breeding," and also because in 466 instances, where measurement was resorted to, the average distance from cesspools "was found to be 37·3 feet."

Inspection of slaughter-houses is conducted in Freetown, and it is recorded that among 4,098 bullocks there was infection with *Cysticercus bovis* in 20 cases.

The Senior Sanitary Officer makes a special plea as to the necessity for providing a separate Port Health Officer for Freetown, instead of expecting the combined duties to be performed by the newly-appointed Medical Officer of Health. He shows that a total of 666 steamers entered the Port during 1913.

Both the Principal Medical Officer and the Senior Sanitary Officer comment on the insanitary condition of rest-houses for officials on tour, these being at times nothing but huts reserved in the interior of native villages that may have been inhabited by natives but shortly before the arrival of an official. The latter officer points to the necessity of better arrangements as the logical sequel of "improvement of the housing at headquarters."

Remarks.—The "Colonial Office forms," which require information as to practical application of sanitary measures, are duly appended to the Report, and disclose facts showing that the Health Officer, Freetown, has much work before him before the Municipal Sanitary

organisation can be rendered complete. For example, neither in the case of the 77 houses of Europeans nor of the 5,239 houses occupied by natives has any mosquito proofing been undertaken, and this is equally true of residences of railway, civil and military officials. From a Note attached to the form as to buildings, it is not possible to ascertain from official sources what, if any, buildings have been erected without sanction. Presuming there are five inhabitants per house in a population of 34,090, there are enough private latrines for only 625 inhabitants. Instead of about 1,600 cubic feet of solid and fluid excreta, which might be expected from this population (largely grain and vegetable feeders), the total removed from the town site is about the product of 2,000 of all ages. The rest of the excreta is disposed of either in cesspools or on the town site. Where pails are employed by the Municipality there are no night soil men to clean the latrines, and no arrangement is made to cleanse the pails. The method of transport and collection of rubbish is probably both inefficient and extravagant of human labour. Table 10, as to "work of disposal of excreta, refuse and offal," as also Table 11, stating "daily numbers of cartloads," etc., are blank—leaving scope for surmise as to methods employed—or their absence. Of 928 barrels employed for water supply in a town where yellow fever is not an unknown visitor, 63 only are mosquito proofed. The total year's work as to drains—which according to Dr. KENNAN, Dr. PROUT and their predecessors are desirable—was an addition of 300 lineal yards; the nature of the drain is, however, unstated. Allowing for no work on Sundays, it required eight hours' labour for five men to oil a little over eight drains or cesspools per day.

GOLD COAST (1913).*

Medical Section.—During the year, the combined medical and sanitary staff consisted of 53 Medical Officers with one Principal Medical Officer and his Deputy, two Provincial Medical Officers, and three Senior Medical Officers. The Sanitary Staff consisted of the Senior and Junior Sanitary Officer, four Medical Officers of Health, four European Sanitary Inspectors, aided by a Native Sanitary Staff of 41 male Sanitary Inspectors and two female Sanitary Inspectors. The area of the Colony is 80,235 square miles and the population 1,501,000.

The Medical Officers treated 2,565 cases of malarial fever against 2,268 in the preceding year. The diagnosis was verified by microscopic examination in the case of 170 Europeans and 460 natives. No death amongst the cases treated was recorded. There were 21 cases of blackwater fever with seven deaths. One of the cases proving fatal was that of a native, to which Dr. HOPKINS draws special attention as rather an unusual circumstance. Of yellow fever it is stated that it is "looked upon as an endemic disease." Eleven cases occurred in Europeans with a mortality of 54·5 per cent., and nine amongst natives with a mortality of 22·2 per cent. The sanitarily important fact is stated that "one case (European) occurred at Kintampo, Northern Province of Ashanti, and four cases (three Europeans and

* GOLD COAST.—Medical and Sanitary Report, 1913. [Principal Medical Officer, F. G. HOPKINS; Senior Sanitary Officer, D. ALEXANDER.]

one native) occurred in the Northern Territories." Apparently, there is no previous record of yellow fever in these dependencies. Such extension cannot be viewed without alarm ; but the Principal Medical Officer is able to state that, following energetic action by the Senior Sanitary Officer and staff, no epidemic resulted. Of guinea worm 1,524 cases (or 231 cases more than last year) came under treatment. In reference to the possibility of prevention, the opinion is given that "it is difficult to get even the educated native to boil his drinking water." Nevertheless, the Medical Section of the Report ends with a statement of faith in the steady advance of hygiene in the Colony, as reflected in the statistics dealing with Europeans :—

"It will, however, be observed with satisfaction that the general death-rate is reduced from 1·96 to 1·12 in the preceding years to 0·86 for 1914, and that is the fact we always hope for from year to year, basing our hopes on the large strides which sanitation is making in this Colony."

Sanitary Section.—It is impossible to show how far the native population has benefited by the sanitary improvements effected, owing to the collection of vital statistics not being general.* The sinews of sanitation being money (for "within human limitation, health is purchasable") the Senior Sanitary Officer, after pointing to numerical deficiency in his staff, gives pride of place to a consideration of the money placed at disposal. Under general sanitation, estimates allowed £43,822, and no difficulty in spending this seems to have occurred; but, in addition, "£41,350 was ear-marked for sanitary improvements under Public Works extraordinary . . . . and £26,035 was expended" —a short expenditure as to which no explanation is offered in the Report.

Southern Nigeria (1913).†

Medical Section.—In the absence of vital statistics, data as to disease prevalence are necessarily confined to deductions from Hospital Returns. According to these, if the years 1911 and 1912 be excepted, in the period from 1907 to 1913 there was no diminution of malarial fever exhibited.

Trypanosomiasis is confined to the Eastern Province, where there were under observation and treatment 378 cases. In an appendix to the Report, Dr. Scott Macfie records much useful investigation, which leads him to conclude : "The morphology of the trypanosome differs in some respect from that of the typical *T. gambiense*, and it is possible that it is not the same species. It remains to determine the species of insect that transmits the disease to man in Eket and the animal that acts as reservoir." He shows that the sleeping sickness of Eket is characterized by its chronicity and mildness. Dr. Gallagher supplies a paper discussing the history of and preventive methods against this disease, showing that Mr. Eakin and Dr. R. W. Gray and Dr. Foran have, since 1906, taken action on the subject. Dr.

* Figures given on page 87 for the principal towns yield on the census (1911) of the aggregate general population of 100,104 a death rate of 24·1 per mille.

† Southern Nigeria.—Annual Medical and Sanitary Report, 1913. [Principal Medical Officer, T. Hood ; Senior Sanitary Officer, J. A. Pickels.]

GALLAGHER makes a plea for regarding well regulated agriculture with its necessary clearings as the best feasible mode of defence against the trypanosome.

In the Eastern Province, filariasis is present to an undetermined extent of prevalence; in the Western Province, 40 per cent. of the adult subjects examined exhibited microfilariae. *Filaria nocturna* and *diurna* are found in about equal proportion—the *perstans* being comparatively rare. About 0·17 cases medically treated are of tuberculosis; but the Principal Medical Officer considers tuberculosis is far more common than disclosed by the Hospital Returns. Leprosy is found in the Western and Eastern Provinces and on the left bank of the Niger. As to tetanus the P. M. O. states:—

"This is very common in Lagos and prevails all the year round. Slight and neglected wounds of the feet are the usual mode of infection. Forty-six cases were treated, with 15 deaths, a mortality so low that it suggests the probability that the native may enjoy a certain degree of immunity to the disease. Anti-tetanic serum is used freely in the treatment."

It is considered fairly safe to estimate that ankylostomiasis is present in 50 per cent. of the people.

The average number of European officials resident was 842; of whom 22·8 per mille were invalided and 8·5 per mille died. In Lagos the death rate per mille of the general population was 29·1 in 1913, on an estimated population of 64,096.

[The rates for Lagos in the preceding four years show a marked diminution from the maximum of 37 per mille in 1909. Ebute Metta has been also fortunate; whilst, in 1909, its death rate was 38·2, in 1913, it had declined to 29·1. In both cases there was a marked diminution of the birth rate in the three latter years of the decade as compared with 1909 and 1910, which is not accounted for in the text; but, as the infantile death rate at Lagos in 1913 was 263·8 per mille of births, and in Ebute Metta 253·8, there does not seem much room for thinking that the death rates have been diminished by the smaller birth rate. Possibly, the estimated population of these two towns, on which the figures are reckoned, and the actual populations differed, in the period concerned, owing to special causes. Whilst the chances are therefore in favour of a considerable diminution of mortality which may be ascribed to sanitary improvements, its extent can hardly be safely gauged by the figures in question.]

Yellow fever was officially declared to exist in Southern Nigeria for the first time in its history. "Ten cases occurred in Europeans with four deaths, three in Syrians with two deaths, and 21 in natives with nil mortality." The P. M. O. suggests that the mildness of the disease in natives may not unreasonably be attributed to the possible fact that practically all are attacked in childhood.

Sanitary Section.—The Sanitary Staff consisted of the Senior Sanitary Officer with one Sanitary Officer, aided by three European Sanitary Inspectors and 24 native Sanitary Inspectors. In addition, there are entertained by the Railway and by Native Court Funds, 26 Native Sanitary Inspectors. Arrangements have been sanctioned by Government for the training of a better educated class of Native Inspectors.

The outbreak of yellow fever in Lagos and other ports brought about increased vigilance as to mosquito destruction, so that

"the reduction in the total mosquito index from 11·1 in 1911 to 5·06 in 1912, and 3·77 in 1913, speaks eloquently enough of the work done." Dr. PICKELS has, however, cause for dissatisfaction in respect to work in this direction accomplished at Abeokuta, under Native Government which entertains a Health Officer "and a few poorly trained Sanitary Inspectors." He considers that it is from the territory thus administered that the first infection of a European with yellow fever occurred, and urges the desirability of better sanitary control of an area that must at all times otherwise be a danger spot to Nigeria.

A total sum of £2,466 was spent during the year on mosquito proofing of houses. The death rate from malaria was 4·2 per 1,000 cases treated amongst Europeans, and 3·02 amongst natives. In the interests of prophylaxis against malaria during 1913, 1,948,330 grains of quinine were issued free of charge.

The Senior Sanitary Officer* remarks on the rarity with which subsoil drainage is carried out by Engineers, but finds a good sign in the race-course at Lagos having been thus rendered in good order. He estimates that surface drainage demands in Lagos 80 miles of public street drains. A form advised by Professor SIMPSON has so far been laid down to the extent of 20,000 feet. During 1913, 4,385,861 square yards were cleared of bush.

In reference to dysentery, the Senior Sanitary Officer notes that an increase of recorded cases resulted owing to new arrivals in jail bearing this disease with them. The stools of new admissions were therefore systematically examined. He adds that the "water for prisoners is rendered sterile and kept in drums fitted with taps and good covers."

In the Central Provinces, tuberculous cases coming to notice were six times more than in 1912. It is proposed to establish a Sanatorium at Ibadan for consumptive prisoners.

It was expected that before the end of 1914 the water-supply scheme for Lagos would be completed. The Calabar water-supply scheme is also sanctioned. The water-supply for Abeokuta is now in working order.

In Lagos night soil collection is conducted on the pail system in an area of 117 acres out of a total of 1,500 acres of the Sanitary District of Lagos. The pails are conveyed by a steam tramway, and the contents are dumped into the deep sea. It is anticipated this method will have to be changed as the harbour is increasingly used by ships.

EAST AFRICA PROTECTORATE (1913).†

Medical Section.—Dr. MILNE considers that the epidemics from which the Protectorate has suffered are not reflected in his Hospital Returns; and he therefore regards with no regret a steady increase of patients, the figures for 1911 being 85,958; 1912, 93,408; 1913, 108,520. He holds that "the increase is an index of the expansion

* The Sanitary Section of the Report is signed by the Acting Senior Sanitary Officer, R. LAURIE.

† EAST AFRICA PROTECTORATE.—Annual Medical Report, 1913. [Principal Medical Officer, A. D. MILNE; Chief Sanitation Officer, W. J. RADFORD.]

of the country attributable to augmentation of the European population bringing with it increasing commercial prosperity, together with medical activity and a yearly increasing number of natives under civilizing influences."

In the Coast Zone anaemia is fairly common, and is usually considered due to malaria, although ankylostomiasis is also present. Diabetes was found amongst Indians, but not amongst Africans.* During the year there were three cases and one death from blackwater fever in Europeans. Amongst other races there were eight cases and two deaths from this cause. In the Mountainous Zone, on the one hand, and in the Kenia and Nyanza Provinces, on the other, there were three and one cases of black-water.

As no reliable vital statistics are available, the Hospital Returns are utilized. These are not analysed so as to exhibit localities from which cases are derived, nor is there anywhere quoted either the splenic or endemic index rates. Dr. MILNE is not in a position therefore to afford very definite information as to the extent of prevalence of malaria. He, however, shows that the number of cases treated has increased from 10,714 in 1911 to 12,656 in 1912, and 15,656 in 1913. He explains this increase as follows :—" Though this table shows an increase in the number of recorded cases, there is a distinct decrease in case incidence in localities where a general knowledge of the cause of this disease is being acquired."

Cerebro-spinal meningitis resulted in much mortality in the Kenia and Nyanza Provinces. Dr. Milne states :—" The visitation which broke out during the year was the most disastrous the Province of Kenia has experienced since occupation by the white man. . . . The District Officers variously estimated the excess rate at from 3 to 10 per cent."

At Kisumu plague prevailed, but it did not reach the Kenia Province.

Dr. Milne accompanied Professor W. J. SIMPSON, C.M.G., on his tour of inspection (during his deputation to Africa by the Colonial Office), and testifies to the strenuous efforts which followed towards the organizing of " a vigorous anti-plague campaign " and the drafting of a much-needed Public Health Code. The Chief Sanitation Officer, in referring to the same subject, gives it as his opinion that having regard to the existence of epidemics of unequalled magnitude, " the benefit the Division has received from his [Professor SIMPSON'S] experience and advice is incalculable."

Sanitary Section.—Dr. RADFORD reports that the sanitation division was brought into existence on the 1st April, 1913, the three Medical Officers of Health of Nairobi, Mombasa and Kisumu being transferred for the purpose ; but further appointments were made, including the Chief Sanitation Officer, four European Sanitary Inspectors, one Nurse and three Sub-Assistant Surgeons. In consequence of epidemics of plague, cerebro-spinal meningitis and small-pox, ten temporary appointments of Medical Officers were made, whilst the subordinate staff was increased by one Sanitary Inspector, two Assistant Surgeons transferred from the permanent staff, eight Sub-Assistant Surgeons obtained from India and one Engineer.

* As regards this disease as it exists in the tropics, this fact is worthy of attention in the investigation promised in the Madras Presidency.

Against malaria quinine prophylaxis was pursued at the jail, Health Offices and Civil Hospital, and at out stations where the King's African Rifles and Police are stationed. Anti-mosquito gangs were employed at Mombasa, Nairobi and Kisumu. Dr. R. SMALL is reported to have taken special interest in the question of roof guttering affording shelter for mosquitoes. At Nairobi, the defective state of drainage is held responsible for the free breeding of anopheles. In the Hospital at Nairobi 31 Europeans were treated for malaria, with one death. The important statement is made that consequent upon conditions at Nairobi " a large number of native labourers are infected on the way to and during their stay in Nairobi." The Medical Officer of Health, Kisumu, reported of Uganda Railway employees that, when the disease was prevalent, 30 per cent. of their number were on the sick list from malaria.

No hospital is mosquito proof and, excepting one room in one house, only nine houses in the whole of the Protectorate are mosquito proof.

Plague is reported to have been epidemic in the District of Mombasa and sporadic at Nairobi, Machakos, N'darugu, Kyambu and Dagoretti. Only 272 cases were, however, " certified by the personnel of the Medical Department." In these the mortality rate was 86·76 per cent. Special and useful Reports by Captain SKELTON, R.A.M.C., and Dr. L. LOWSLEY are attached as appendices to the Report of the Chief Sanitation Officer. The rat gangs employed in the townships at Nairobi, Mombasa and Kisumu caught 1,656, 2,882 and 10,183 rats, respectively—figures showing no relation to the human population of these places, but giving to the gang at Kisumu with only 6,582 inhabitants the palm for activity. Plague inoculation was pushed energetically, but is not supported by law.

On the subject of dysentery Dr. Radford ascribes spread to polluted water and the action of flies. The majority of cases are of the bacillary type.

The severity of the epidemic of cerebro-spinal meningitis has already been noticed in dealing with the Medical Section above. Dr. Radford not only corroborates the statement, but holds that its incidence was so overwhelming as to forbid any effort at suppression with the small staff at his disposal, except in the immediate vicinity of Nairobi. The Provinces were attacked in the following order :—Ukamba, Kenia, Naivasha, Seyidie, Nyanza, Tanaland. He makes the following important observation :—

" The greatest virulence and highest death-rates occurred in the highlands in Ukamba, Kenia, Naivasha, and North Kavirondo ; *i.e.*, at an elevation of between 3,500 to 7,000 feet ; and while the coast belt remained practically untouched, it is of great interest to record the fact that the number of cases was greatest during the cold weather—viz., May, June, July and August—and case incidence gradually declined as the hot weather set in. This period also coincides with that of comparatively dry weather."

Sanitary measures against the epidemic seem to have consisted largely of the use of quarantine and segregation huts for patients and contacts.

A special plea is made for the preservation of the purity of the streams at Nairobi, by diversion of sewage to a farm and treatment

of the effluent before discharge. The argument is enforced by reference to the enteric fever epidemic of 1911 at Nairobi which, he states, "was traced to an infected water-supply."

The remainder of the Report shows that the important subjects of town and house planning, inspection of laundries, bakeries, dairies and of trade generally are receiving careful attention, and that given time and sufficient staff the new Sanitation Division will render sound public health service to the Protectorate.

United States Army (1913–14).*

This is the first Annual Report issued by Surgeon-General Gorgas. As might be expected at the hands of that famous sanitarian, there is from beginning to end of his dealing with what might otherwise be exceedingly dry statistics, a search for evidence of weakness in the application of systems of disease prevention, demonstration of their value when correctly adapted to conditions and, finally, exhortation to the authorities he advises as to both the humane and economic value of applied hygiene.

The experience gained by the American Army, as in the case of the British, is by no means confined to temperate climates. The Returns deal with American troops in Alaska, the Panama Canal Zone and China; and not only with coloured troops in America but with native troops in Porto Rico and the Philippines. It is characteristic of the sanitary experience of Surgeon-General Gorgas, gained largely on the Panama Canal where economy and effectiveness of paid labour were the aim and outcome of his efforts, that at no point of his discussion of figures does he fail to impress his readers with the importance of the rate of "non-effectiveness," which is the equivalent of the heading in British Official Returns, "constantly sick." He is able to show a steady decline of this rate under all causes from 41·19 per mille in 1908 to 22·94 in 1913.

Surgeon-General Gorgas, in the interests of reduction of non-effectiveness, seems determined to do his utmost to secure full attention to the disability caused by venereal diseases. For several years efforts to educate the American soldiers as to prophylaxis have been made. In 1911, the non-effective rate from this cause was 8·82. In 1912, a War Department Order was issued directing a "compulsory system of venereal prophylaxis and physical inspection," aided by the stopping the pay of those disabled on account of sickness due to alcoholism, drug addiction, and other misconduct (venereal diseases)." The result has been that by 1913 the rate declined to 3·58 per mille.

The connection between intemperance and venereal diseases in respect to neglect of personal prophylaxis (provided for by the issue of special packets) is probably, the writer suggests, the chief factor concerned in the decrease, but Gorgas would leave as little to chance as possible, and where a return to barracks from the site of infection involves delay he advises as follows:—

"The chief surgeon of the Eastern Department has noted in his annual report, soldiers do not seem to be willing to purchase the packets. Many exchanges report few, if any, sales, and apparently either the K packet

* United States Army.—Report of the Surgeon-General of the U.S. Army for the Fiscal Year ending 30th June, 1914.

must be distributed without charge to the soldier, or passes should be restricted to such time as would bring back those likely to be exposed to infection before the time had elapsed during which prophylaxis is effective."

In the Philippines the venereal admission rate exceeds that of the United States, and this sanitarian does not hesitate to insist that military officers who are responsible for the effectiveness of their men should not be held blameless. He states :—

". . . . Several posts have continued to develop a higher rate rather than a lower one, and it is believed that the time has come when the commanding officers should be held accountable for excessive prevalence of venereal diseases in their commands. They certainly would be so held for excessive alcoholism or any other drug addiction, and it is believed that the 'military instinct' should perceive as readily the value of maintaining a high state of physical efficiency through a low venereal rate as of keeping the 'powder dry.'"

In forwarding the Report to the Secretary of War, Surgeon-General Gorgas thus finally urges the importance of diminishing the venereal non-effectiveness rate :—

"The economy to the Government effected by these recent measures is worthy of note. At the rate prevalent in 1909 when this propaganda against venereal disease was beginning to take its present form, the expectation for the number of days lost in 1913 in the Army by sickness through venereal diseases would be 391,000, the number actually lost in 1913 was 137,882 ; an apparent saving of 253,118 days resulted for the year. The time saved was available for military training and other duty. The monetary value was approximately $190,000, and under the former conditions this sum actually would have been paid out by the Government. At date of writing it is probable that one-and-a-half million men are under arms in the armies of the Allies in France. Applying the same rates to those armies, it would mean a saving of 4,200,000 days in a year, or the equivalent of an army of 420,000 for 10 days. The value of the services of men thus saved to duty is apparent."

In a recent "Sanitation Number" of this *Bulletin* (No. 7 of April, 1914 page 362) the facts concerning the period when anti-typhoid inoculation was voluntary in the American Army, as compared with the period of compulsion (1911), were detailed. The satisfactory result then stated was well maintained in 1913. In that year the troops were scattered along the Mexican border and in Texas in camps.

"Amongst these troops not a single case of typhoid fever has occurred in an inoculated man since June 4th (1912). One case of typhoid occurred then in July and one in October, 1912, but in neither case had the prophylactic been administered. For the American Army, including native troops, at a strength of 81,697 the total admissions for typhoid in 1913 were only four, affording a rate per mille of ·004. Three of these cases occurred in America. Two of these cases were in recently enlisted recruits who were admitted to the hospital with the disease, one on the fourth and the other on other on the sixth day of service. The latter case had not received the first dose of the typhoid prophylactic when admitted to the hospital. In both cases the disease was obviously contracted prior to enlistment. In the third case the prophylaxis was employed for more than a year previous to the attack, but the soldier stated that he had received only *one* injection. One case occurred amongst the American troops in China. This patient had been inoculated in 1911. No other case occurred either amongst the American or native troops at home or abroad. All the patients recovered.'

In the Philippines, amongst American troops, the malaria admission rate has decreased from 167·79 in 1907 to 112·08 in 1914. The decline of dysentery is not so complete, the admission rate, 20·83, being higher than in 1910 (19·39). The rate for tuberculosis was 6·70 per 1,000. The mental alienation rate for American troops was 4·83 against the United States rate of 2·92 per mille ; a result which, the writer thinks, would seem to support the argument advanced in this *Bulletin* (No. 4, August, 1914, p. 220) that this factor can hardly be of no import in judging the influence of tropical conditions on the white man.

DISEASE PREVENTION.

Malaria.

Impounded Water and Malaria.

Senior Surgeon H. R. Carter, U.S.A. Army, has recorded* the results of a very thorough examination into the influence of water impounded (for power purposes) upon the breeding of anophelines. The matter in certain parts of the United States is or vast financial importance, in respect to possible legal disabilities being imposed upon companies, should the health conditions of communities be threatened by malaria.

He was deputed to examine conditions caused by impounding the river Pee Dee at a suitable point (Blewett's Falls) for a dam. He found the structure an accomplished fact, and uses this as a text for urging that a sanitary survey of localities selected for impounding water should be held *before* execution of the work is undertaken by engineers. Obviously, if the Sanitary Officer be provided with plans showing the proposed contour line of water, he would be able to indicate where work should be undertaken to limit its spread in certain directions. In the particular reservoirs examined, the dams were sufficiently high to produce a backwater of considerable depth for several miles, involving water spread over the catchment of numerous lateral supply streams.

This survey confirms the advantage of the old procedure of covering marsh land with deep water when it is not feasible to drain or fill it, in that the anophelines have but the choice of the margin of the mass of water for breeding purposes. It also proves that where the sides of the reservoir are steep wave action is inimical to larvae; that entangled masses of floating scraps of wood are liable to transport larvae from distant localities; that if these masses be hindered from being thrown upon dry shores by being caught in partly submerged bushes, mosquito breeding is favoured; that where the level of the impounded water alternately rises and falls within one or two feet, as a result of additions of fresh water and its exit (for example, for power production and its temporary cessation, with continued influx in the reservoir), "within a shorter time than the cycle of development of the mosquito," propagation is prevented. He notes the disadvantage of shelter by bushes in shallow water, grass, weeds and algae.

His observations on shelter afforded for mosquito breeding by bushes obstructing small floating material give support to the remarks of Dr. Kennan, Senior Sanitary Officer, under the head of "River overflow swamp," in the Annual Report of the Medical Department of Sierra Leone for 1913 (p. 80). That officer states:—

"After the rains commence and when they become continuous and torrential, many of the large rivers overflow their banks, and, by their rise in level, cease to allow the free passage of drainage from low lying areas beyond their banks. . . . . Most usually the depression in the

* United States Public Health Service, Public Health Report of December 25th, 1914, and January 1st, 1915.

bank which in the dry season allows exit for the stream draining the low-lying area to the river, is a narrow one compared to the area drained. When the water level rises in the river, the low-lying area becomes a lake from the combined effect of overflow from the river and retardation of drainage. Of course, it is not beyond the power of engineering science to deal satisfactorily with such situations, but in the Protectorate of Sierra Leone such schemes are not feasible. As was pointed out in a previous Annual Report such low-lying areas, where desirable on account of their proximity to towns, should be thoroughly cleared of low bush, so that as the water rises the appearance of a lake with surface unbroken and with even edges is presented, except perhaps where the trunks of tall trees carry branches and foliage above it. The subject is reverted to because the measure is a very simple one for political administrators to encourage."

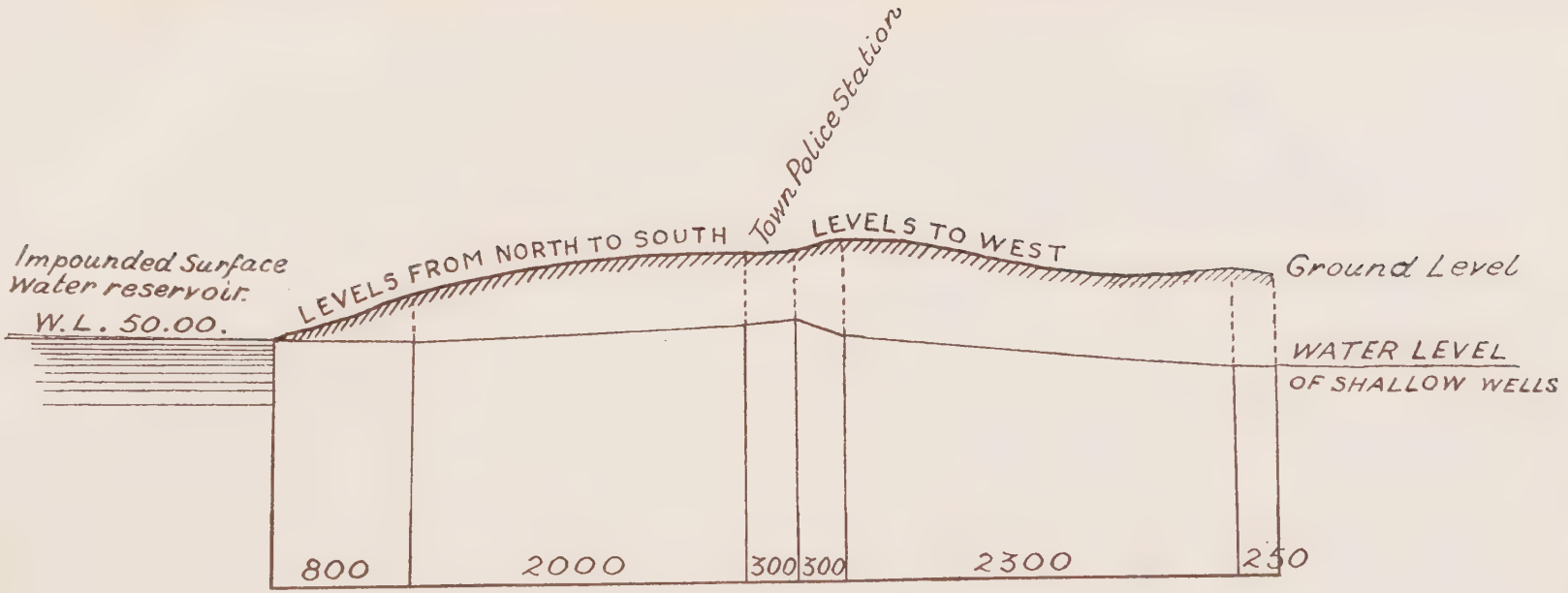
Influence of the Hydrostatic Pressure of Impounded Water on Mosquito Propagation.

Senior Surgeon CARTER, to whose work reference is made in the preceding note, was deputed to ascertain changes brought about by impounding of water in the river valley *above* the dam. He therefore makes but one casual reference to the area below the dam :— " Below the dam this territory was breeding Anopheles profusely over a wide extent of marshy flat used as a pasture. It was breeding much less above the pond." This illustrates a sequel of the impounding of water that is to be met with largely under conditions found in India. Whilst, under British rule, magnificent irrigation works have been formed by diverting water from rivers by canals over huge areas of country, important impounding reservoirs have been rarely built, if that of Periyar, in the South of India, be excluded*. But, under Indian rulers, the expedient of impounding surface waters by raising horse-shoe embankments, on sloping catchment areas or fed by short channels from streams, is frequent in certain parts of the country. The embankments are ordinarily of very great breadth and are devoid of impervious cores. The method of construction with the earth available on the spot was by dumping basket head-loads, and thus a good grade of solidification was secured when aided by the tramp of crowds of coolies. Silting gradually helped to make an approach to impermeability of the bottoms of such reservoirs ; but it is probable, irrespective of occasional defects in the embankment permitting leakage, that the bottoms are rarely uniformly impermeable. These reservoirs (locally known as " tanks ") are the normal features of minor irrigation works, especially in areas with gradients permitting the surface water overflow of one tank to pass to the next lower down. Indian villagers do not ordinarily construct their villages on the catchment above an irrigation tank, but below it, so that they may utilise the discharge channels and be near their fields.

Under the latter typical circumstances, as the tank above a village fills, the immediate neighbourhood below it becomes water-logged as a result of hydrostatic pressure, and in sympathy with the

*At Lanavli, in the Bombay Presidency, there have recently been completed by Messrs. Tata and Sons, two impounding reservoirs capable of affording by a hydro-electric system more than 160,000 h.p. The Periyar lake, originally constructed for irrigation purposes in the Madras Presidency, is also capable of use for electric power.

Fig. A.



Scale: { Horizontal $\frac{1}{10000}$ / Vertical $\frac{1}{200}$

subsoil water the level of wells is raised. The result is the forming of marsh and (what perhaps especially aids the breeding of certain anophelines) small basin-like pools through which a gentle current of clean water flows. In short, a condition is liable to occur more or less corresponding to that described by Senior Surgeon CARTER below the dam of the water power work inspected by him. In that case, however, not only would leaks under hydrostatic pressure within the reservoir, but also the substream of the impounded river Pee Dee be factors concerned.

Provided the cutting is not placed in such proximity as to endanger the embankment under pressure from the contained water, an obviously possible remedy is the use of a subsoil drain either of loose-jointed pipes or loose rubble (Irish drains) placed between the tank and the village and at a sufficient depth effectively to lower the maximum sub-soil water level.

Should, however, the village be built on the upper side of the gradient and in a line with an impounded surface water reservoir, the effect may be that of obstructing the sub-soil water flowing towards its normal outlet, and thus cause inimical influence by direct raising of the sub-soil water within the village area ; this would occur ordinarily by causing the soil to approach a state of saturation by capillary attraction from the sub-soil water layer, thus readily allowing formation of pools on rain occurring, or by directly producing pools in depressions. An instance of such obstruction of subsoil water by a tank in the case of a malarious town in the Madras Presidency is shown in the accompanying sheet of levels (fig. A). In this case even when the tank is emptied of impounded surface water, the bottom extending over 600 acres, although possessed of a sharp slope, remains marshy under the influence of the subsoil water held up by the embankment of the reservoir on the lower portion of the gradient.

Water-Covering as an Anti-Malarial Measure.

This subject was referred to in this *Bulletin*, Vol. 4, p. 186 (Sanitation Number). Senior Surgeon CARTER'S inspection of effects of water spread has been discussed in a preceding note. Lt.-Col. MASON (Medical Corps, U.S. Army) makes the following observations on the same subject (*Report of the Department of Health, Panama Canal*, April, 1914, p. 36) :—

> " The banks of that part of Miraflores Lake adjacent to Pedro Miguel are being cut at an angle of three-fourths on 1, from the 55·5 feet level to that of 53 feet, in the hope that a depth of water and an amount of wave action sufficient to prevent mosquito breeding may be obtained, and much labour and material at present expended on treatment of the lake with oil and larvicide thus be saved."

It is evident that the old ruling that the sides of a drinking water reservoir shall be cut so as to give a depth and slope sufficient to prevent the growth and decay of vegetation incidental to alternate rise and fall of the contained water, is also applicable, in a modified degree, to all ponds for whatever purpose employed, in the interest of prevention of mosquito breeding.

Anophelines and Subsoil Water.

A high subsoil water in a locality implies the possibility of oozing and forming of pools in depressions below the general ground level and, owing to saturated condition of soil by capillary attraction, a ready formation of pools at ground level on the occurrence of rainfall. Dr. Bentley in Bombay (preceded in Madras in 1900 by Lt.-Col. Cornwall I.M.S.) showed the importance of wells within inhabited areas in facilitating the propagation of anophelines. Dr. Allan, Acting Medical Officer of Health, Freetown, now proves that in Sierra Leone the varying depth of wells greatly modifies their suitability for this purpose. The writer would suggest that a fair deduction from this work is that a new way is disclosed in which subsoil water by its fluctuation may influence seasonal malaria. The important observations of Dr. Allan* (which must have involved much labour) included a study of locally found mosquitoes, but are here only referred to in regard to conclusions in respect to depth from the ground level of well surface water. He states :—

"The method of examination adopted was by means of a net, consisting of a barrel hoop of 2 feet diameter covered with two layers of book muslin. This was lowered down to the bottom of the well and then pulled rapidly up. The larvae were examined for by washing the net in a large basin of water. . . . . The number of wells examined was 418, and in 22·5 per cent. of these larvae were found. Of these *Culicales* were found in 75 per cent. and *Anophelinae* in 34 [? 24] per cent. Species of both *Anophelinae* and *Culicales* were found in some wells. Of the *Anophelinae* bred out and examined, *Anopheles costalis* was the species in every case. Of the *Culicales*, *Culex decens* was the most common species found. *Culex tigripes* was found in a few wells and in one *Culex insignia* was found. (All the above were diagnosed in the Imperial Bureau of Entomology). Stegomyia was also found."

Culices were found in wells with water rather dirty, and the surface at ten feet below ground level. But anophelines seemed to prefer wells whose surface level was not so deep and where weeds, moss, etc., were evident. When the subsoil water was so high as to afford a surface level of 5 ft. from the ground 57·7 per cent. of the larvae infected wells held anophelines, but where the level fell to an average of 24·5 ft. below the ground the proportion of anopheline-infected wells was only 15 per cent. Stegomyia (the species being *fasciata* "in every case") were found in wells with surface levels at various depths, and seem to prefer those where there were old and disused covers, pieces of wood, &c., floating on the surface of the water. Dr. Allan states that this examination must not be considered concluded, as there were at the close of the year still 250 wells to be examined.

Roof Guttering.

Dr. R. Small, Medical Officer of Health, Mombasa,† directs special attention to roof guttering as "one of the main breeding places [of mosquitoes] in that town." In the Annual Medical Report for 1913 (Southern Nigeria), Dr. R. Laurie, Acting Senior Sanitary Officer, states that "great attention has been paid to eaves, gutters,

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*Sierra Leone.—Report of the Medical Department, 1913, p. 69.

†East Africa Protectorate.—Annual Medical Report. 1913, p. 37.

for even though they are punctured in sagging places, it not infrequently happens that the holes are stopped up with putty or wood, or they become blocked with dirt from the roof, and a special gang of men has been found useful in keeping the gutters cleaned and the punctures open. When possible gutters have been removed as it has been found, on several occasions, that even though a tank is mosquito-proof larvae have been found in the water." Surgeon-General Gorgas* also inveighs against roof gutterings :—" Comparatively recently it has been discovered [in the case of Fort Washington, Md.] that mosquitoes were breeding in the catch basins and wells, and also in eave troughs that did not completely discharge all rain water reaching them."

Difficulty in dealing with roof guttering is therefore not confined to Africa. Hence, the writer suggests that where mosquito-borne diseases exist, its use should be so limited by legal rulings as to make its construction possible only under clearly proved conditions of necessity. Dr. Laurie's description of arrangements at Mombasa show that when malarial efforts are hampered by attention to roof gutters a *reductio ad absurdum* may be reached ; on the one hand, by the object of the house owner to provide for a complete flow of rainwater from the roof in a preconceived direction being frustrated by holes made by public officials in his gutters and, on the other hand, by public funds being spent for the keeping open of these holes.

Under the circumstances, it is worth while considering as to whether at times roof guttering is not maintained in the absence of real necessity. As to protection of exterior walls of dwellings, it is certain that in countries where monsoons may shed their torrents for weeks on end (e.g. Lower Burma) they can be dispensed with. To meet this condition, houses should be provided with pent roofs at sharp angles. In designing roofs, " valleys " should be avoided, and the eaves should be prolonged† outwards and downwards so as to carry the rain clear of the walls without the aid of gutters, even if this implies that the water flow may be over the roof of verandahs. Right round houses so constructed should be an apron of concrete or other impervious material, within which should be a drain leading in the required direction. In this manner, the apron would be a continuation of the concrete filling of the basement and would form a protection not only against damp and subsoil air but against rats.

In some places roof guttering is intended for the collection of rainwater for drinking purposes, and is hence regarded as essential. Whilst acknowledging that localities exist where this cannot be avoided, the writer suggests that these may be diminished in number by careful search for other sources of water supply ; and that there is no merit in using gutters, tanks, barrels, rainwater separators, screening, etc., plus staffs to supervise them. If roofs must be so used, in at least the case of houses within their own compounds, less care is required to keep the rainwater drains round a house clean

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* United States Army.—Report of the Surgeon-General, 1914, p. 64.

† At p. xiv of the illustrations appended to the Sierra Leone Annual Medical Report for 1911, a bungalow is shown with the eaves thus extended. At p. 29 of the Gold Coast Medical and Sanitary Report for 1913, it is stated experiments are being made with "storm boards"; so far results are said to be satisfactory.

to enable the water to reach underground reservoirs, than if the roofs had gutters, especially as the periodicity of rains in the tropics allows timely preparation. Beyond the fact that a roof presents the advantage of a ready made impervious surface for collection, it has no virtue ; and it might well be that were the prime cost to householders of roof gutters and their various attachments and maintenance taken into account a good case, financially, could be made out for communal rainwater supplies derived from areas rendered artificially impervious, in those rare cases where no other source of supply than rain water is feasible.

Agriculture and Malaria.

The agriculturist requires for the assimilation of manures by plant life that the soil voids shall not be constantly filled with water the soil must have aeration. Hence, irrespective of control of surface water (so that the soil may not be robbed of its plant food by velocity of flow), he demands that water-logging shall not occur, and consequently is a strong advocate of subsoil drainage. Sanitary interests in agriculture are, therefore, not only concerned in food production and in the return to mother earth of that which was derived from her, but in treatment of soils by drainage; for here the sanitarian and agriculturist can unite in defeating the deadly enemy of labour—malaria. This is no new discovery. The fact that by surface and sub-soil drainage—one or both—malaria could be exterminated was fully recognised many years before Ross showed that the connection between water, soil and malaria was the propagation not of a germ, but of mosquito larvae. When this fact was established, there should naturally have ensued an increase of radical measures to abolish malaria—the chief of which is drainage. Instead of which the pointing by Ross to minor anti-malarial measures for destruction of larvae as also applicable cheaply, whilst he in no way deprecated the importance of drainage, was held by some civil authorities controlling the purse strings as a reason for ignoring drainage and its attendant expenses.

Many years elapsed before Ross in respect to the Phœnix barracks, Gorgas at Panama, and Malcolm Watson at Port Swettenham showed by drainage works the importance of radical as contrasted with palliative measures. The latter authority especially has made a point recently of proving the economic importance to the agriculturist of such works. Much of this attitude of opposition to "drainage" is also perhaps due to the fact that to laymen the term implies the use of expensive material and expert engineers, such as they have been accustomed to see employed within municipal towns. The difficulty is added to by the fact that engineers, of a class capable of making abstruse calculations for the construction of bridges and great irrigation works, are apt to regard subsoil drainage of large areas as a petty matter which concerns agriculturists, and hence is a subject to which they have given little thought.* The matter becomes, however, much less formidable to the average lay official if the sanitarian confines his terms to "relief of surface and subsoil waters," and refers in a particular case to the

*Dr. Laurie, Acting Senior Sanitary Officer, Southern Nigeria, in his Report for 1913 (p. 42) states under the heading Subsoil Drainage :—"This important subject has hitherto received little attention from the engineers of Southern Nigeria.

various means by which that end can be secured without confining himself to the financially dreaded word "drainage."

It is well recognised that to the relief of subsoil and surface water in the course of improved agriculture and land reclamation the present immunity of Great Britain from malarial fever is due. But it is apt to be forgotten, when referring to anti-malarial work of the present day, that 50 years back the French by large works in Algiers favoured agriculture and largely stayed malaria.

In 1867, the British Government appointed a Commission composed of Dr. SUTHERLAND, J. POYNDER, D.I.G. of Hospitals, and Lt.-Col. C. B. EWART, R.E., to report on the result of these anti-malarial works upon the health of the French Army. The following typical extracts from this old Report* should aid sanitary officers in dispelling doubts of local authorities as to the efficacy of dealing both with surface and subsoil waters by permanent works :—

Draining of Marsh Land.—Lake Halloula (15,000 hectares of land) was drained at a cost of about 5s. 5½d. per acre. The main drainage canal was 5½ miles long with numerous subsidiary channels. "The effect on the neighbourhood has been decisive. The villages which formerly suffered severely from remittent fevers, often taking the form of pernicious fevers, are now healthy and they have been freed of mosquitoes which during a part of the year made life almost intolerable." The Commission was therefore within a measurable distance of anticipating the connection between malaria and mosquitoes, but lost the opportunity !

Agriculture without Drainage.—The Commission considered that Foudouk was improved but not freed of malaria by simple agriculture—not accompanied by drainage.

Extra-mural Works.—It is noted that Bona had originally deep rich alluvial soil saturated with water. "It was determined to drain the plain by means of large deep main drains similar to those executed in marshy districts at home, and by forming a system of surface drains over the area led into the main outfall. Market gardening and agriculture [were conducted] over surface."

Intra-mural Works.—"Subsoil pipe drains were placed at depths varying from 3 feet 6 inches to 6 feet 7 inches, according to depth required to secure the necessary fall. They were laid in lines in the public streets. The practical result of the work has been that whereas formerly the water level was at above the surface of the ground, it is now 20 inches or more below the level of the surface. . . . A good water supply accompanied the drainage works." The mortality of the population, which in 1843–1846 was 57 per mille, was reduced in 1865 to 18 or 20 per mille. "Pneumonic fevers are said to have disappeared since the works were executed, and other milder types of fever are of rare occurrence." The Commission finally remarked :—"The first thing that struck us on entering the town was the healthy aspect of the people, especially the children, and some we saw would have been a credit to the healthiest spots in England so far as appearance went."

*Parliamentary Paper No. 19,447. Report on the Causes of the Reduced Mortality in the French Army serving in Algeria. Published in 1867.

Agriculture the Ally of Sanitation.—To the conclusion of the Report the writer would especially invite attention :—

"The whole evidence goes to show how much the general health of all countries is dependent on the condition of their agriculture, that in warm climates this is really a fundamental consideration, and that in all countries the health of the people and their progress in material improvement are indissolubly connected with each other. It is in this way that agriculture becomes in reality as essential a part of Sanitary Administration for improving the health of the country population as drainage, water supply, cleansing and general town improvement are part of the public hygiene of towns."

At no point would the sanitarian and agriculturist find larger ground for co-operation in the tropics than in respect to management of "wet crops," more especially of rice. It has long been recognised by the sanitarian that it is not the act of irrigation which has to be dreaded, but the fact that the agriculturist, in spite of a few laws—neglected usually in the financial interests of water owners—persists in using more water than is really requisite for his crops and allowing the surplus to flow whither it lists. When then Mr. HARRISON, of the Madras Government Agricultural Department, makes a statement founded not upon theory but upon "a series of carefully designed experiments" during several years to the effect that "drainage, or at least some movement of the soil water, is essential for paddy cultivation, and especially so when bulky organic manures are applied," there becomes evident the possibility of a new era in the protection of populations from malaria.* From the agricultural point of view also Mr. HARRISON'S work is regarded as of great value, as Mr. D. T. CHADWICK, I.C.S., the Director of Agriculture, states that a control experiment at Manganallur, which corroborated Mr. HARRISON'S views, and that officer's "work are two of the most important and instructive local agricultural events of the year." His important memoir on the aeration of paddy and on the intimate relation of green manuring and drainage was also completed.

The Bombay Government defines the precautions necessary from an agricultural point of view in pursuing wet cultivation under the Gokak Canal, as follows :—"The three essentials are that the fields should be levelled, that water-logging should be prevented by proper drainage, and that water channels should be kept water-tight, as straight as possible and free from weeds." Obviously, these precautionary measures might as well have been written for prevention of malaria. Agriculture on scientific principles is likely to become an important ally of sanitation in tropical countries in the near future.

Dry Zones in Malaria.

The Sanitary Commissioner with the Government of Madras in his Annual Report for 1913 (p. 8) is able to record a reduction in fever mortality in the Municipal Town of Cuddapah from 4·5 to 2·1 per mille, a result which he ascribes to "prohibition of wet cultivation in and around the town and to the anti-malarial measures undertaken during the year at the instance of Major T. S. Ross." As wet cultivation prohibition was enforced in this town in 1904, and as the death rate is now 35 per month against 47 of 1893 (to which allusion is made

* Report on the operations of the Agricultural Department, Madras, 1913.

in a note under Vital Statistics in the present number), the dry zone doubtless has not been without influence; although it is obvious that there existed plenty of room for the carrying out of modern anti-malarial methods. In the presence of a system of wet cultivation when drainage and regulation of waste are absent, should malaria exhibit itself, it is probable, so far as the important question of flight of mosquitoes has been worked out (this *Bulletin*, Vol. 4, p. 448), that, whilst dry zones of a small radius will afford much protection, the mile required by DEMPSTER was a very fair approximate estimate for safety. The great point in fixing dry zones is that the periphery shall at all points be the defined distance from the outermost dwellings of the place to be protected. The tendency is for public authorities to be satisfied by ruling prohibition within their own areas of administration, regardless of irregularities of demarcation of their limits in respect to neighbouring authorities, and to forget that to profit by this course drainage must still be zealously cared for within the so-called dry zone.

In 1881, the writer persuaded the Municipality of Kurnool (Madras Presidency) to enforce a zone of a mile radius. Irrespective of absence of knowledge in pre-Ross days as to the connection between mosquitoes and malaria, and consequent failure to take appropriate action, the zone was surreptitiously infringed from time to time. Nevertheless, even under these unfavourable circumstances the method proved of distinct value. The registered death rate from "fevers" per cent. of all causes declined as follows:—

1879–1883	.. .. ..	64 per cent.
1884–1888	.. .. ..	49·5 ,,
1889–1893	.. .. ..	54 ,,
1894–1898	.. .. ..	43 ,,
1899–1903	.. .. ..	46 ,,
1904–1908	.. .. ..	36 ,,
1904* ..	.. .. ..	19 ,,

It may be added that within the zone dry and garden crops were encouraged in place of rice cultivation, but no suggestion for control of channels for such crops or of drainage was accepted by the local authority, in the face of vested interests. After 1904, the dry zone was retained within the municipal limits, and as these did not conform so fully to requirements it is unnecessary to trace the results.

Fish Farming and Larvicides.

The Agricultural Department of the Madras Presidency does not limit its operations to land. It has branches dealing practically with the economic aspects of fish culture, both in fresh and salt waters. Incidentally it has undertaken, on behalf of the local authorities, experiments determining the value of certain fish as larvicides and the maintaining of stocks of these. Mr. H. C. WILSON, the Piscicultural Expert to the Government of Madras, at the 2nd All India Sanitary Conference, read a paper on the subject in which, as a result of very carefully conducted experiments guarded by controls, he was able to furnish definite and valuable opinions. He expressed the belief that

*In 1904 the Chief Civil Officer of the District required better observance of the zone.

having found a genus of fish that would readily devour mosquito larvae the choice should rest with that species which is more rapid in its movements, and by its colour would be the least liable to detection; for he sees no reason to doubt, from careful observation, that the mosquito, more especially when laying her eggs or disengaging from the pupa state, has an instinctive watchfulness. He comes to the following conclusion :—

"1. Genus—*Chela* (all species are useful, but the smaller ones are the best.)

"Geographical distribution of genus according to DAY :—Sind, Continent of India and Burma, including Malay Archipelago.

"Class of waters where these species would be of greatest service: tanks, swamps and village ponds.

"The members of this genus are not good travellers, but if taken n properly constructed carriers can travel considerable distances safely.

"2. Genus—*Haplochilus*—DAY gives four species. Geographical distribution of the genus, India, Malay Archipelago and beyond, tropical Africa, Islands in the Indian Ocean, also temperate and tropical America.

"Best suited for stocking wells, channels, stagnant pools, and any mosquito-infested waters at long distances from the breeding grounds.

"These fish are exceedingly good travellers and if properly prepared for a journey (conditioned) and not overcrowded, can be kept in the same water for days together, the water requiring very little aeration.

"3. Genus—*Therapon.* Species, *Therapon jarbua.* Geographical distribution of the species (DAY): From the Red Sea and East Coast of Africa through the seas and estuaries of India to Malay Archipelago and north coast of Australia. These are suitable to stock backwaters, salt and brackish swamps and pools near the coast. These fish can also be used in fresh water ponds.

"They travel fairly well if care is taken."

Fish Larvicides or "Filling."

The following extract from the Report on the operations of the Department of Agriculture, Madras, 1913, tends to prove that a judicious choice of fish for stocking ponds may result in saving much expenditure in filling. Mr. H. C. WILSON says :—

"I was asked to advise the Madras Corporation on the best means of dealing with mosquito larvae in the numerous tanks in and around Madras; for this purpose I made an inspection together with the President and the Medical Officer. On my advice the tanks which otherwise would have had to be filled in are being kept clear of weed and stocked with larvicides. Up to the present time the President reports that it is working most satisfactorily and practically no larvae can be found where the instructions have been carried out."

The writer would add that the stocking of ponds with larvae-eating fish has been long practised in the Canary Islands (Teneriffe) as a preventive of mosquito breeding in the interests of domestic comfort.

Drinking Water and Malarial Fever.

Much writing occurred in the past over the question of the supposed conveyance of malarial fever by drinking water. In the opinion of the uneducated Indian, the *fons et origo mali* is water. Mr. WILSON, the Pisciculturist expert referred to in the preceding note, affords an opinion

as to the usefulness of frogs as larvicides and, at the same time, suggests the origin of the supposed connection between drinking water and fever :—

"The 'bad' well may contain murrel (Ophiocephalia), a natural enemy of the frog, which would keep it clear of frogs and small fish. The presence of frogs in the 'good' well shows there are no murrel, and it is highly probable that some small larvae-eating fish will be there also. The mosquitoes would naturally favour the so-called 'bad' well, as it is the safest breeding ground, and multiply rapidly. It would be reasonable to suppose that a number of these will become infected with malaria germs by biting visitors to the well and so spread it. The fever is then put down to drinking the water of this well."

The writer believes that many of the "step wells" of Indian villages of ancient origin (so made that the drawer of water descends by steps to the water level) have shaded recesses where mosquitoes perhaps rest in comfort during the hours of sunshine.

Malaria Gamete Bearers not always Infective.

In the course of experiments as to identification of anophelines as true malaria bearers, the following important result was arrived at :— "These experiments also called attention to the fact repeatedly observed in the laboratory that not every gamete bearer is infective during the entire period in which gametes are present in his peripheral blood." (*Report of the Department of Health, Panama Canal,* 1914, September, p. 8.)

Yellow Fever.

Screening or Larvicides.

Asst. Surgeon Converse, U.S. Public Health Service,* undertook to convert the town of Iquitos, Peru, a notorious hotbed for yellow fever, into a reasonably healthy locality. The old bogey of "want of funds" at disposal of local authorities, familiar to sanitarians in all parts of the world, defeated the radical scheme contemplated in consultation with an engineer, after it had been duly elaborated. Makeshift methods were therefore resorted to.

The town of 12,754 inhabitants, mostly Indians, is described as possessed of no sewers but, in lieu, it had 18 kilometers of open drains— "a succession of mosquito breeding pools. There is no public water supply. Its streets were unpaved; many of them are boggy and marshy; some are covered with a rank growth 3–4 feet high, others with both water and vegetation. It has no hospital or public clinic." The average death rate for the decade preceding 1913 was 40·58 per mille; but, in 1912, the rate was 49·52 per mille. Altogether, therefore, Asst. Surgeon Converse had, in the absence of funds, no light task before him.

Under the euphemism of "vomito-negro," a disease supposed to be peculiar to the locality, he recognised that yellow fever was endemic. Screening and fumigation of houses was out of the question, owing to the cost locally of material. He, therefore, was confronted with the

* United States Public Health Report. 1914. Vol. 29. No. 46.

alternative of adopting a compaign having for its "one object the location and destruction of the breeding places of the Stegomyia.".. The various steps of the campaign have been—employment and training of native inspectors; the passage of the necessary Ordinance; obtaining the necessary larvicidal material; clearing up, screening, destruction of larvae; educating the people." The larvicide was of the same character as used in Panama but, pending arrival of this, kerosene oil was employed. Presumably under the ordinance referred to, "the burden of clearing up and screening water containers was placed entirely on landlords and tenants."

Mosquito nets were used for yellow fever patients in the infected blocks, and every container of water was kerosined. There were no secondary cases—"although the first day and night of illness were passed without any screening whatsoever." For the rest, Asst. Surgeon Converse shows that his work was one of persistent action against the larvae of the Stegomyia and, as he puts it, consisted of the "usual thousands of inspections, screenings, abatement of nuisances, cartloads of tins etc. removed, being the same as in all work of this character."

The result of this work has been a splendid illustration of the great utility of anti-larval and other minor sanitary measures, in staying yellow fever and general mortality, and is thus modestly stated by Asst. Surgeon Converse :—

"The net results of these routine operations and general clear up are that, although in previous years yellow fever had never failed to be present in epidemic form at some time of the year, there has not been one case of the disease since February, 1913 (18 months), and the general mortality rate dropped from 49·52 in 1912 to 22·88 in 1913. That this diminution in mortality was not produced by a reduction in population was shown by census and also by birth rate, which rose from 59 in 1912 to 64 in 1913."

Portable mosquito-proof Rooms.

During 1913, an epidemic of yellow fever occurred in Lagos. Its advent was prepared for by causing the European ward and several native wards "to be adequately mosquito proofed." In addition, the excellent precaution was taken of having ready mosquito-proof portable rooms $9' \times 10' \times 8'$. It is reported that "these rooms can be set up in half an hour and proved extremely useful."

Plague.

Transport of Rats.

The following are extracts from the East Africa Protectorate Annual Medical Report (p. 41 and 74) for 1913 :—

"One fact is pre-eminently established—that plague is following the trade routes, and that the Uganda Railway with its fleet of lake steamers is a direct agent, not only of introducing the disease by means of infected cargoes brought from places outside the Protectorate, but also of transmitting it from Kisumu to other lake ports.....Instances have occurred where plague infected rats have been found in cotton and hides brought from the lake ports into Kisumu, and again after fumigation of the ship at that port, officers and crew have succumbed to the disease a day or so

subsequent to the departure of the ship from Kisumu.....Where these infected rats came from has not, so far as I know, been discovered. It may be presumed that the original rat may have come down by train in merchandise from Kisumu or Nairobi. I am informed that rats have actually been seen to emerge from grain vans on the railway.....There has been no recurrence of plague in any disinfected house since the arrival of the Clayton machine."

The fact that before the use of sulphur fumigation cases recurred in houses is of utility, more especially as it is supported by the statement that in houses Claytonized, in which guinea-pigs were subsequently placed, none died of plague. The experiment however, would have been more exact if, before disinfection, it had been proved that infection of guinea-pigs was possible.

Mummified Plague Rats.

These are frequently found during plague operations, but their ability to be harmful is naturally doubted in view of the assumed desertion of the flea, and death of the plague microbes in the presence of saprophytic organisms. In the following case,* the connection with living plague bacilli is complicated by the fact that the rat was within an enclosed space, and that the faecal matter of the flea (living, say, 12 to 20 days after the last infected meal) may have been in contact with the remains of unknown date which were "ground up" for testing. It is, at any rate, noteworthy that after the time required to mummify a rat, there were living fleas of which one (a *Pule cheopis*) "showed bipolar staining organisms that were identical with those of plague" :—

"Mr. William Crozier, the Editor of the *Manila Daily Bulletin* who had his office in the Stewart Building, was taken violently ill....his case was definitely diagnosed as one of plague.....The diagnosis was completely confirmed by laboratory methods. While carrying out the insecticidal and other antiplague measures in his office, a mummified rat was found in a drawer of his desk. There were also in the drawer a number of live fleas, one of which was captured and identified at the Bureau of Science as the rat flea (*Pulex cheopis*). Stained specimens from this flea showed bipolar staining organisms that were identical with those of plague. The mummified rat or large mouse which was found in his desk was taken to the Bureau of Science, ground up, and inoculations made from it into healthy laboratory rats produced typical cases of plague in them."

Vital Statistics of Rats.

Estimates varying with the country have been made, during plague operations, as to the number of rats in relation to the human population of towns, but to arrive at a normal death-rate of rats would add to their value. The Bureau of Public Health, Philippine Islands (Report July to Dec. 1913, p. 34) thus treats the subject :—

"There is at least one rat per inhabitant, but, in order to err on the safe side, let it be supposed that there is only one rat for every two inhabitants. The average life of a rat is said to be approximately five years. In round numbers, the population of Manila and its environs is about 300,000 persons. On the foregoing basis, there would be a natural mortality of 150,000 rats for each five-year period, 30,000 rats per year, 2,500 per month, or an average daily mortality of 82 rats."

* Philippine Islands Bureau of Health Report. July to Dec. 1913. p. 102.

The Flea and Fly Count.

The Report of the Department of Health of the Panama Canal for September (1914, p. 7) details the following method of making a flea count :—

"The method of combing rats for fleas—particularly plague-infected rat fleas—presents certain disadvantages which have been obviated by the following method :—From several tests it was found that fleas began to leave a killed rat as early as fifteen seconds after death, and all had left the body a little more than two hours and fifteen minutes afterwards. We therefore killed the rat by cephalotripsy, and immediately placed the body on a glass rod grating over a collection of water in a very large glass jar or the inverted cover of a garbage can ; either one will answer the purpose. The fleas soon began to leave the rat's body and drop into the water, and may be conveniently collected by means of a medicine dropper. We have obtained higher counts in this way than by chloroforming and combing or by any other method."

At page 12 of the same Report, it is stated that one quart of flies represents 13,000.

Stable flies as Plague Carriers.

G. W. McCoy and C. W. Chapin* showed that a "plague-like" disease prevailed amongst rodents—particularly squirrels—due to *Bacterium tularense* and could be contracted by man. In the human being there occurred "conjunctivitis with cervical adenitis and considerable systemic disturbance." The disease is readily transmitted to rodents without shaving the skin, by such small traumatism as may be caused by holding the skin with forceps, or rubbing the conjunctiva with a grain of sterile sand under the eyelids. Death results in five or six days in the guinea-pig. When an animal suffering from bacteraemia during this disease is bitten by stable flies (*Stomoxys calcitrans*) they are capable of transmitting it to an unaffected animal, if it be bitten within one hour. If the house fly (*Musca domestica*) be allowed to pass over the viscera of an animal dead of this disease, and be transferred to the conjunctiva of an uninfected animal, the full symptoms of the disease and death follow.

Assistant-Surgeon Wayson now supplements McCoy's observations by showing that *Stomoxys calcitrans* can convey not only the "plague-like disease," but "plague" proper, if allowed to bite an animal suffering from bacteraemia in that disease. He states that the minimum number of bites necessary has not been determined but that "in two experiments when flies were allowed to bite an infected animal eight times death resulted. . . . . Further information is also desirable regarding the transmission of plague by the stable fly, since this fly will feed on carcases recently dead. Definite information might explain the occurrence of cases of this disease which do not lend themselves readily to an epidemiological explanation by flea transmission."

Cyanide Fumigation.

At the 3rd All India Sanitary Conference, Major Glen Liston, C.I.E., I.M.S., detailed a series of elaborate experiments which had been undertaken by him, aided by Captain Stevenson, I.M.S. and

*United States Public Health Bulletin, No. 43 of 1911, and 53 of 1914.

Captain Taylor, I.M.S., concerning the action of hydrocyanic acid gas as a disinfectant, with special reference to the killing of rats and fleas.

Whilst the danger of this gas to human life is admitted, it is held that with reasonable precaution its use should be safe. The light character of the gas, and the extent of its penetrative powers in the disinfection of grain (as to which the superiority of sulphur dioxide is acknowledged, offer difficulties which have to be overcome. They established that grain subjected to exposure to the gas is not rendered poisonous nor incapable of germination. To enable the presence of gas to be detected (irrespective of its characteristic odour), they prepared a " paste by mixing in a dry mortar caustic soda and ferrous sulphate. This is applied to a glass rod and the rod is exposed to the gas for a definite period. A few drops of hydrochloric acid are then added to the paste on the rod, and the rod is stirred up in some water in a test tube. The development of a prussian blue colour gives a rough idea of the concentration of the hydrocyanic acid gas if the paste is exposed for a constant period."

To overcome the difficulty caused by the light character of the gas, they contrived an ingenious machine. This consists of an iron drum-shaped reservoir termed the mixing chamber. This is served with the gas from a reservoir (the "generating chamber") formed of a glass bell jar surrounded by a water seal, and resting on a leaden cup-shaped base. There is communication by pipe between the generating and mixing chambers.

The gas is generated by " mixing together solutions of potassium cyanide and sulphuric acid of 50 per cent. strength. The two solutions were placed in two large separator funnels which led through a rubber bung at the top of the bell-jar ; by means of stop cocks, the two solutions were allowed to flow at any desired rates into the lead vessels below. When the two solutions mixed hydrocyanic acid gas was rapidly evolved. The rate of production of the gas could be delicately regulated by the stop-cocks, and by observing the evolution of the gas through the gas bell-jar. We were able thus, at the beginning of fumigation to produce large quantities of gas by running in the two solutions rapidly into the leaden vessel, and later, by running the two solutions less rapidly, we could keep up the concentration of the gas in the room which was being disinfected."

In the side of the mixing chamber, there are inserted india rubber tubes, one communicating with the space to be disinfected (in which all openings are closed, as usual when employing gaseous disinfectants), the other with a fan, so that air charged with the hydrocyanic gas may be withdrawn and again forced into the space. They summarise their results as follows* :—

" (1) Hydrocyanic acid gas is an effective disinfectant for plague, not because it has any direct action on plague bacilli, but because it kills rats and fleas. The fact that rats do not generally live in grain bags, but in the spaces between them and that fleas do not bury themselves in grain to a greater depth than the gas can penetrate ensures that they are readily accessible to the action of the gas.

" (2) The gas can easily be generated, distributed and diffused through rooms, godowns, and the holds of ships by the apparatus we have devised.

*Proc. 3rd All-India Sanitary Conference held at Lucknow Jan. 19–27, 1914. Vol. 5. Papers. (Suppl. to the Indian Jl. Med. Research), p. 167.

"(3) Owing to its characteristic odour and to the existence of a simple and delicate chemical test for its presence, this very poisonous gas can be used with safety by persons who exercise a moderate amount of caution.

"(4) This gas does not injure the most delicate fabrics or metals and does not render food unfit for consumption; grain will germinate after exposure to the gas.

"(5) No light or heat is required for the production of the gas, so that the danger of fire or explosion is non-existent.

"(6) The cost of chemicals for generating the gas is small; twelve thousand cubic feet can be treated for about three rupees and four annas.

"(7) The generating apparatus we have used is fairly portable. A single machine would suffice for the disinfection of an ordinary Indian dwelling, but a battery of five or six machines would be required for the disinfection of a large ship or godown.

"(8) The gas being slightly lighter than air can be easily removed from rooms, holds, etc., by ordinary ventilation.

"(9) The quantity of gas required for efficient disinfection will depend on the air-tightness of the room to be treated, the time the gas is allowed to act, the thoroughness of the distribution and diffusion of the gas, as well as on the cubic capacity of room and whether it is full or empty.

"(10) In general we have found that from $\frac{1}{2}$ to $\frac{3}{4}$ of an ounce of Potassium cyanide per 100 cubic feet of space to be treated should be used. The gas should be allowed to act for about four hours. In small rooms which can be fairly tightly closed half an ounce of Potassium cyanide per 100 cubic feet will suffice and the period of exposure can be reduced to one hour. If larger spaces are treated, such as godowns and holds, especially if these are full of merchandise, $\frac{3}{4}$ of an ounce of Potassium cyanidewill be required and the gas should be allowed to act for four hours."

This subject has also been receiving attention at New Orleans, U.S.A., by Passed-Assistant Surgeon Norman Roberts.* The danger of using this gas is recognised, but it is held that it can be guarded against by "vigilance on the part of the fumigator and the ship's officers." He employs two methods—the "crock" and the "barrel." In both cases, for each 100 cubic feet of space he uses one fluid ounce of commercial sulphuric acid to three ounces of water; to which, subsequently, as directed, is added one ounce of potassium cyanide.

The "crock" is a cheap glazed cylindrical stoneware vessel of about a gallon capacity. It may be used for spaces under 5,000 cubic feet, provided the fumigator is able to make a rapid exit. It is therefore unsuitable for holds of vessels. The sulphuric acid, having been mixed with the water (preferably whilst still hot), is placed in position, in the space closed except for purpose of exit of the fumigator, who drops the proportion of solid cyanide into the one or more "crocks"—and bolts.

In the barrel method, which is suitable for holds of ships, any large barrel will do, but it is advised that it is "advantageous to char the inside of the barrel and line it with a small quantity of paraffin wax driven as deeply as possible into the wood by heat; but untreated barrels, originally in good condition, appear to last for several fumigations without marked deterioration if not subjected to the action

* United States Public Health Reports, 1914. Dec. 11. No. 50.

of unduly strong acid, as by mixing the acid and water in the barrels without sufficient stirring. A 50 gallon barrel will serve for the decomposition of about 80 pounds of cyanide (125,000 cubic feet of space), but it is better to use much smaller charges (20 to 30 pounds—30,000 to 45,000 cubic feet of space) and more barrels, on account both of the difficulty of handling barrels full of a troublesome liquid, and of the faulty distribution of the gas when given off from a single source into a large hold complicated by cargo barricades and decks." The method pursued is as follows :—

"Fumigation is carried out by diluting the acid with part of the water in the barrel, which is then swung down to the lowest accessible point in the hold ; the cyanide, previously dissolved in the remainder of the water, is then poured into the barrel from the deck by means of a pitcher and funnel through a long rubber hose. After the cyanide is all in, it is followed after a few seconds or minutes by a strong sodium carbonate solution, which expels part of the dissolved hydrocyanic acid from the waste and reduces the remaining acidity, thus economizing on the expensive cyanide and rendering the waste less poisonous, corrosive, and troublesome."

Remarks.—Both the Bombay and New Orleans experiments will doubtless secure greater use of the cyanide method, but there will naturally arise demand for further research on certain of the points raised. Both realise that information is requisite as to securing correct distribution of the light gas, and as to its penetrating powers. Assistant-Surgeon ROBERTS gets rid of the latter detail, at once, by asserting that, "For use against plague, it has the great advantage that it penetrates most articles of cargo without damaging, killing the vermin *no matter how deeply hidden.*"* But he fails to support this statement by any experiments *ad hoc ;* and leaves it unproved that, when he increases the density of the gas, by what is apparently a mere mechanical mixture of carbon dioxide with the hydrocyanic acid gas, a differentiation does not rapidly occur by the heavy gas passing to a lower level, followed by very slow general diffusion of both. The Bombay experiments attempt to get over the diffusion question by using nine distribution pipes, but give no idea of the fan power requisite to secure equable results, complicated as this must be by resistance from friction offered by multiplication of tubes. Judging by a handle attached to the fan, manual power is intended to be used. Nor, whilst a circulation of the contained air and gas to and from the mixing chamber is arranged for, is it shown what position within the space under disinfection is advised for the withdrawal pipe, although it is evident from the illustration of the machine which accompanies the paper, the light gas is introduced by the distribution tubes at the bottom of the door of the room and that the withdrawal tube is at the top, which theoretically would hardly be suitable. Again, experiments have been conducted in spaces up to 12,000 cubic feet, but as a barge with two holds of 600 was employed, the chances are that the *vertical* depth was small ; yet in treating the holds of sea-going vessels, the depth must be of importance, in relation to the possibility of the light gas failing in killing power at the bottom. These matters are chiefly mechanical and should present no difficulty, but are of importance if the method is to be largely utilised.

*Italics not in the original.

As to penetrative power, the Bombay experiments have approached the subject with care. Although the fact that a rat was found in a bag of grain sent to Chitral, seemed at one time to threaten a dis proportionate view of the importance of grain traffic by certain members of the Plague Investigation Committee, they now assume from actual experiments that the rat as well as its flea is content with living external to bags of grain, and "that the fleas did not penetrate far enough to avoid the lethal effects of the gas in loose layers of grain." The experiments on this latter point whilst clear as to the limits of penetrative power of the gas in rice (between one and two inches) are vague as to how the limits of voluntary efforts of fleas were determined.

In contrasting the effects of hydrocyanic gas with sulphur dioxide as a microbe as well as an insect killer, the Bombay record attempts to disarm criticism, by asserting that the microbe killing virtue of the latter gas is negligible in plague, and refers to the experiments by the Plague Investigation Committee with plague contaminated floors showing them to be innocuous by mere exposure within twenty-four hours; but fails to point out that at periods within this time, according to the nature of the floor, they are not innocuous.

The writer, whilst agreeing with the opinion that rats do not burrow into bags of grain (although they may arrive there by accident in loading) and that in the presence of commencing decomposition the plague microbe disappears in the body of the rat, suggests that possibly exceptional mummified rats and certainly their fleas within bales of merchandise (see a preceding note) or bags of grain cannot be regarded as harmless, nor disinfectants as fully effective, if their penetrative power be doubtful.

Whilst, therefore, cyanide fumigation has been advanced by the Bombay and New Orleans experiments in scientific and practical value, it is undesirable, without more evidence than shown by either, to accept passed Assistant-Surgeon ROBERT'S dictum as to the penetrative powers of the gas, if contrast be made with sulphur dioxide. Thus HALDANE and WADE* in describing destruction of typhoid bacilli in the presence of 0·5 per cent. of sulphur dioxide show that the following were the conditions :—

"Before the cultures could be affected in the above experiments the gas had to penetrate many layers of material, viz., several thicknesses of blanket and wrapping paper, a mass of cotton wadding, several thicknesses of tissue paper and finally the tightly packed cotton-wool plugs of the culture tubes. The conditions are as drastic as any that would be likely to occur in practice. As a still more stringent test, two packages made up in the same way were placed in a steel trunk loosely filled with clothes. One of the packages was buried among the clothes, and the other was placed on the top of them covered by a blanket. The trunk was then locked, so that the only means of access of the gas was through the space between the body and its somewhat badly fitting lid."

* Local Government Board.—Report of the Medical Officer, 1903, p. 330.

Cholera.

The Human Carrier.

Under Sanitary Rulings, it is shown how the importance of the human carrier has been guarded against in the Philippines. The *Report of the Bureau of Health for the Philippine Islands*, for 1913, advances the hypothesis that the cholera vibrio may be present in human carriers, yet not cause an epidemic outbreak until by successive passages through the intestines its virulency is exalted. The action of various insects as carriers of the microbe to food is being studied systematically.

In India, Major Greig, I.M.S., has insisted upon the importance of the human carrier, and has shown that the biliary passages of men afford excellent shelter for the cholera microbe. In a more recent research, he has shown that there is no evidence to support the view that the "endemic prevalence depends on the vitality of the cholera vibrio outside man" (*Proc. 3rd All-India Sanitary Conference, held at Lucknow, Jan.* 19 *to* 27, 1914. *Vol.* 4. *Papers.* Supplement to *Indian Jl. Med. Research.* p. 99).

Cholera and River Surface Water.

Water obtained from substreams of rivers, collected by infiltration galleries or wells, offers many advantages in regions in the tropics where the surface flow in the river beds departs with the rainy season. When public supply water works thus depend on infiltration water, during the rainy season the surface water at a site above the works for a town may be suspected of conveying cholera.

The River Cauvery, in the Madras Presidency, certainly seems capable of conveying cholera to towns and villages on its banks. Thus, in a carefully compiled statistical enquiry, the writer came to the conclusion that it is possible this river conveys infective matter without destruction for a distance of eighteen miles, and that on a tributary, the Bhavani, for every ten villages within five miles of either bank of this river 1·34 were affected against 0·24 in every ten beyond that distance.

It is conceivable that either by an extension of the drainage cone, by leakage in the works, or a fault in the sub-stream formation, an infiltration gallery or well might be supplied with a certain amount of surface water.

The infiltration wells of the Trichinopoly water works, South India, gave trouble from floods and other causes, so that, at intervals, for some years it was necessary to supply the town by pumping surface instead of infiltration water from the Cauvery. The following data apparently show that a substream water is a safer source of supply than a river surface water, if neither are to receive special treatment before delivery. The data lack the control experience of delivery of surface and river water to inhabitants of different areas, at the same time. There is also no verification that the particular inhabitants

infected did drink either one or the other water. There is, however, sufficient evidence to give weight to this opinion:—

Years.	Jan. S.	Jan. I.	Feb. S.	Feb. I.	Mar. S.	Mar. I.	Apr. S.	Apr. I.	Oct. S.	Oct. I.	Nov. S.	Nov. I.	Dec. S.	Dec. I.
1898 ..	*a* 161		321		8		*d* 60		—		1		82	
1899 ..	*b* 273		79		14		*e* 1		—		—		—	
1900 ..	3		33		5		—		—		25		*h* 143	
1901 ..	44		69		*c* 15		—		*g* —		65		112	
1902 ..	41		14		2		*f* —		2		2		—	

Remarks.—*a*=From 27th to 31st.; *d*=Up to 23rd; *b*=8th to 31st; *e*=Up to 14th; *h*=From 10th to 31st; *c*=Up to 24th; *g*=No supply from 9th to 27th and surface water from 27th to 31st; *f*=Up to 3rd.

Note.—Where not specified the period was for the whole month.

— = No cholera when the water specified was in use.

S=River surface water. I=Infiltration water.

The figures represent cases of cholera.

Typhoid Fever.

The extension of typhoid fever amongst natives in some of our Colonies is a matter that deserves, and is attracting amongst the officers concerned, close attention, with the object of preventive measures being taken before the disease makes itself more apparent. In Sierra Leone, some indications of spread are noted in the Annual Report of the Medical Department for 1913 (pp. 15 and 75). Dr. Collett states: "The existence of enteric amongst natives has also been observed." Dr. Kennan refers to three cases among officers at Mount Aureol, supposed to have origin in the eating of mangrove oysters from Aberdeen Creek, and also the case of a native soldier at the Wilberforce Barracks. He describes local conditions of water-supply and night soil conservancy which favour typhoid spread, and finally states: "There may be undetermined factors which counterbalance these considerations, but such a possibility cannot justify relaxation of efforts in prevention." No enquiry seems to have been made as to possible sources of contamination of the oysters. It would be of interest to know whether the tidal waters were contaminated.

"Salgas," placed along the banks of a river, as found at times in Africa, may not be without danger. A case of typhoid at Panama is reported "apparently due to the use of water seeping from a bank honeycombed with privy pots." (*Report of the Department of Health* Panama Canal, 1914. Sept. p. 6).

Anti-Typhoid Inoculation.

The Report of the Surgeon-General of the U.S.A. Army (by Surgeon-General Gorgas) shows the results of anti-typhoid inoculation. This was commenced in 1909 as a voluntary measure, and was made compulsory in 1911. Gorgas states: "It is quite interesting to note that among all the troops scattered along the Mexican border, and in the large camps in Texas not a single case of typhoid fever has occurred in an inoculated man since June 4th, 1912." No case occurred amongst the troops in the Philippines in 1913. The admission rates for the whole Army were in 1911 0·85, in 1912 0·31, in 1913 0·44, whilst the death-rates were respectively 0·09, 0·044 and nil.

Small-Pox.

Small-pox in India.

In his Annual Sanitary Report for 1913 (p. 7) the Sanitary Commissioner with the Government of Madras states that the small-pox death rate in municipalities, where vaccination is compulsory in an aggregate population of 2,605,074, is 0·3 per mille, against 0·4 per mille in rural areas where vaccination is practised, but with few exceptions is not compulsory. In both cases vaccination is not practised in infants below six months of age, except in municipalities if exposure to infection is proved. As ceremonies in honour of the goddess presiding over small-pox (to which mothers bring their infants) are largely attended, exposure of the young to infection is considerable. As the inhabitants outside municipal areas number 40,173,578 in a decade, the loss of over 40,000 lives is the penalty for "conscientious objectors."

The Sanitary Commissioner, Behar and Orissa, shows in his Annual Vaccination Report for 1913 (p. 2) that in the Gaya District, where vaccination has been insufficiently accepted by the people, owing to the employment of an undesirable class of vaccinators, the small-pox mortality rate is ·62 per mille; whereas in the Tirhoot District, where such difficulty is not experienced and increase of vaccine operations is reported, the rate is ·12 per mille.

Preliminary Disinfection in Vaccination.

On this subject Lt.-Col. Harriss, I.M.S., Sanitary Commissioner, United Provinces, India, states (*Triennial Report on Vaccination in the Provinces of Agra and Oudh*, 1913):—

"The use of the tincture of iodine in vaccination as recommended by Major E. E. Waters, I.M.S., late Civil Surgeon, Hooghly, was tried on 188 children vaccinated in the Lucknow District. The District Superintendent of Vaccination reported that none of these operations was successful, although the same lymph without the preliminary application of iodine to the arms produced successful results."

Verification of Vaccination Results.

The 1,154 vaccinators of the Province of Behar and Orissa in 1913 reported a success rate of primary vaccination of 99·66 per cent., in 1,283,999 primary cases. This average skill in this number of vaccinators, certain of whom are termed by the Sanitary Commissioner as "particularly dirty and incompetent" is, in the phraseology of Dominie Sampson, "prodigious." Although in the Behar Circle the Deputy Sanitary Commissioner inspected 4·25, District Inspectors 30·27, and Sub-Inspectors 50·46 per cent. of the total cases and the rate of success as found by them was 94·48 and by the Inspectors 97·59 per cent., the corrections do not seem to have made much impression on the total figure for the Province.

In Assam, during 1913–14, 336,649 "primary and secondary operations" were performed with a success rate, according to vaccinators, of 98·47, according to the inspecting staff of 92·83, and according to Civil Surgeons 97·07. In the Punjab, the vaccinators reported on 671,994 cases a success rate of 97·40 per cent., the Civil Surgeon 96·45, whilst the officers of the Sanitary Department found the rate in various areas to be 79·58, 84·37, 89·9 and 91·7 per cent. In Bombay, although the Deputy Sanitary Commissioners travelled in the aggregate, during 1913–14, 8,451 miles for the purposes of inspection, the results of their verification of the total Presidency rate of 99·18 is not recorded.

Whilst much of this difference of opinion is due to the employment of an undesirable class of vaccinators, it is probable that this might diminish if official returns provided for a differentiation between primary and secondary operations. If a vaccinator is allowed to return all cases that are not re-vaccination as primary or group them as "primary and secondary," there is nothing to prevent 1,145 vaccinators operating with such consistent skill as to obtain in spite of deductions by inspections by superior officers 99·66 per cent. of success.

Cory and Murphy,* who were in charge of the first animal vaccine depôt in London under the Local Government Board, certainly were entitled to be regarded as expert vaccinators. They personally used lymph direct from the calf in 5,591 cases. Their rate of success in "first trials" on primary cases was 99·55 per cent.; so that the Bihar and Orissa vaccinators beat them by points.

Cultivation of Animal Vaccine.

Some day it is hoped the above title may imply a laboratory process. In the meantime, an animal must be the medium. At p. 437 of Vol. 4 of this *Bulletin*, the writer has referred to the importance with which the maintenance of a "strain" of vaccine must be regarded, by those in charge of large vaccine institutes amid the difficulties which tropical conditions present. This subject received special care at the hands of Major Patton, I.M.S.,† Assistant Director, King Institute of Preventive Medicine, Madras, and Captain F. W. Cragg, I.M.S. in charge

*Local Government Board.—Medical Officer's Report 1886, No. 4. Appendix A, No. 1.

†Madras Presidency.—Annual Report on Vaccination and on the Work of the Vaccine Section of the King Institute of Preventive Medicine 1913–1914.

of the Vaccine Section of that Institute, during 1913–14. The Director, Lieut.-Col. F. MAITLAND GIBSON, summarises results secured as follows :—

" Attention is drawn in this Appendix to certain improvements f procedure notable among which are :—

" (1) The selection of lymph for seed purposes from a large number of animals vaccinated in the ordinary way. This is entirely in accordance with the practice at the Government Lymph Establishment, at Hendon, London, and has quite superseded the vaccination of special stock animals.

" (2) The three-line method of insertion. This certainly does seem a better procedure for the class of animal and the climate we have to deal with.

" (3) If the reputed improvement in stock lymph when kept in the form of unground and immunised pulp is maintained, a further notable advance will have been made in our technique."

The belief that continuous transmission of vaccine through calves results in attenuation, which is referred to by Major Patton in the opening of his Report, is largely held. It is one, however, that must be accepted with certain reservations when this experience is gained under the adverse meteorological conditions peculiar to a tropical climate. It has always seemed to the writer that if it be the case that bovines afford inimical soil it remains to be proved, and in practice it is negligible, but that in the meantime it is very evident that the adverse conditions to which from generation to generation vaccine production is exposed in a tropical climate must, if not correctly met, ultimately cause degeneration from type; just as surely as in agriculture oats may, by careless treatment, become useless for food purposes. The stock dealt with by Major Patton* is descended from the variola vaccine obtained by the writer in 1891, and although its purity subsequent to 1902–03 was doubtful, up to that time it had been maintained from calf to calf by his former assistant, Dr. PALPU (late Deputy Sanitary Commissioner, Mysore) *in vigour and unmixed with other stocks.*

Acting upon experience gained in an endeavour to improve the stock current before 1891 in the Madras Presidency, the writer was convinced that rejuvenation was feasible for brief periods only by means of retro-vaccine and asino-vaccine.† The buffalo, donkey and goat were also tried as new soils. The first two gave fairly good, but temporary results. On obtaining the variola-vaccine stock, however, it was so vigorous that rejuvenation was thenceforth unnecessary; and, seeing that former efforts had secured a mere increase of vigour in formerly current vaccine, it was directed that on no account should this newly gained stock be mingled with any other for any purpose. Indubitably, the stock required no rejuvenation when passed solely through calves for nineteen years, when treated by the writer's system.

In the writer's preliminary experiments inoculation by punctures few and many, free scarifications in patches, lines of different lengths oblique and longitudinal, single, double and treble, and in groups of small lengths forming square patches on the abdomen, as well as thighs and thorax, were all duly tried. The conclusion arrived at was

* Proc. South India Branch Brit. Med. Assoc. Apr. 1891.
† Indian Medical Gazette, 1914, May, p. 206.

that whilst by certain of these modes the yield of vesicle pulp could be increased, to put the not very vigorous typical calf of Southern India to any strain in the effort to secure quantity by extensive inoculation was inimical to quality; that the most perfect vesicles were produced by subjecting the skin to the least traumatic disturbance feasible—so much so that it was found the employment of a sharp or blunt knife, and the evenness with which the true skin was penetrated by different assistants, represented vast differences in yield; that a silky soft white skin of the abdomen of a vigorous animal gave the best results; that the character of vesiculation within limits varied in different calves, and that by selecting special animals for cultivation of seed lymph. and retaining them under special hygienic and food conditions, the chances were always in favour of close adherence to type on transfer to average calves for vesicle pulp purposes; that in this way, various strains* of lymph could be maintained, and by following rules (first stated by WARLOMENT) vesiculation could be retarded or hastened in development; that where the tendency was not to conform to type (in spite of efforts in cultivation by early or late removal of seed lymph) strains should be abandoned; that to secure such selection of strains, it is necessary to maintain full records of each on each calf inoculated, and that the staff employed should inspect the animals inoculated at hours ordered by the officer responsible, and be prepared to remove the vesicles at the time indicated by him after personal inspection for each calf; even if, as may happen in some of the total inoculated, this were necessary at undesirable hours of night or day. There was of course nothing in such rules which prevented selection of a strain from a calf intended for vesicle pulp (as now practised by the Local Government Board officers and advised by Major PATTON) if it appeared on maturation that an improvement upon a strain had occurred; but in making this selection, the advantage was possessed of a full knowledge of the behaviour hitherto of the particular strain. All this meant a vast deal of trouble at the hands of an efficient and willing staff, but it implied a command over cultivation such as no other method can afford.

When, therefore, Major Patton throws over all power of discrimination of strains and trusts to selection of vesicles from, say, twenty animals, his staff is saved a vast deal of trouble; he has power of selection from a stock instead of from several strains, but runs the risk of a breakdown, such as is not incurred by the more careful method. If the writer's system had, as he believes was the case, gradually fallen into disuse without benefit to the stock, necessarily, the only way open to Major PATTON was the pooling of all strains and selection therefrom.

If the pooling method be adopted, it is well to remember that it is always possible for an undesirable change in the vaccine of a whole series of calves inoculated at the same time to occur which, *whilst evident in the mass, may not be so in selected vesicles, and yet this will surely evince itself in some generations whilst missing others.* This can only be averted by knowing the history of the behaviour of each strain from calf to calf.

* The term "stock" is used in this note to distinguish the various sources of origin of vaccines; whereas the term "strain" is used to distinguish the lineal descendants from a particular stock.

Major PATTON's claim that by using triple lines for inoculation he secures a better result than from single lines may be quite correct as to quantity of pulp, but need not be true as to quality of vaccine.

As to rejuvenation, for which that officer suggests donkeys be used, the writer believes that whilst by change of soil such as transfer from the calf to the rabbit, the donkey, the horse or buffalo—which possibly acts by getting rid of extraneous micro-organisms which had threatened to become all powerful on the calf—some temporary improvement may occur, true rejuvenation can only be obtained by variolation of the calf, and the facilitating of vesicle production by subsequent implantation of vaccine.

Finally, Major PATTON makes an announcement of a new method of treating vaccine pulp before using it for seed transfer, which is an original observation likely to be of great utility. He thus describes the method :—

"Latterly the technique of using the seed lymph has been further improved. If it is not to be used immediately it is without any further treatment placed in a sterile Petri dish and stored in the cold room. When required it is pulped and mixed either with glycerine or with sterile saline solution, and then used for vaccinating the calves. Five hundred and eighty-one calves were vaccinated in this way during the months of February and March, 1914, and 5,413 grammes were collected from them, each calf yielding on an average of 9.31 grammes. All the vesicles were well formed and typical ; the lymph produced normal vesicles on children vaccinated at Saidapet."

The method of temporarily storing vaccine vesicles in a refrigerator during the rush of work until the staff was able to attend to the process of pulping and preservation, is not new at the Institute concerned, but the interval before the preservation process was purposely made as short as possible. Evidently, therefore, Major PATTON must have ascertained that favourable changes occur on a definite lapse of time. His further evidence on the matter should be of great interest, and may greatly modify present methods both in temperate climates and in the tropics.

Yield of Vaccine Pulp in Buffalo Calves.

According to a Report from the United Provinces of Agra and Oudh* the average yield per cow calf of vesicle pulp was 29 grammes, and of buffalo calves 48 grammes. If these amounts of vesicles be collected in an absolutely cleanly condition and free of all scabs they are so large compared with what seems possible in the South of India (as stated in the preceding note) that the breeds at disposal in the United Provinces must be of very sturdy characteristics. Rejuvenation is attended to by the use of rabbits. The vaccine is issued in the glycerinized form. From April to September (hot weather) in 764,699 primary operations the reported success rate was 81·5, but during the cold weather, October to March, this rose to 94·8 per cent.

BERIBERI.

The Chemistry of Rice Polishings.

In a recent *Bulletin* (Vol. 4, No. 4, page 209, Sanitation Number), the views of Dr. CHEVALLIER and Dr. John R. GIMLETTE on the influence

*UNITED PROVINCES OF AGRA AND OUDH. Triennial Report on Vaccination. 1911–12, 1912–13, and 1913–14.

of mouldy rice in beriberi were discussed. Both suggested from a review of epidemics of this disease, in widely different circumstances, that the influence of moulds in destroying the phosphorous constituents of the pericarp was as likely a factor as the polishing of rice, and both urged protection of rice from conditions under which moulds were favoured. Dr. GIMLETTE formulated this view by stating that "hygiene when applied to the imported food supplies of labourers . . . . may be of greater benefit than legislation." This method of regarding the subject is strengthened by the assumed delicacy of the active principles in the rice pericarp. Thus, after alluding to various efforts to effect isolation, an Editorial Note in the *Lancet* (January 23rd, 1913, p. 193), states: "From this it would appear that the so-called vitamine is a readily decomposed base, and it would be interesting to discover what happens to its nitrogen in the processes of nutrition. Usually inert, nitrogen may in a nascent state prove to be an activator." Obviously also, factors other than the artificial effects of polishing should undergo study. Those who have seen great mounds of loose paddy awaiting in rain transport by railways congested with traffic, will appreciate the fact that changes may occur in the pericarp before polishing can have affected it.

Diet and Beriberi.

The following is an extract from the East Africa Protectorate Annual Medical Report for 1913 (p. 22):—

"Dr. PUGH points out that it is not improbable that this disease is more prevalent in a mild form than is generally imagined. Twenty-eight cases were admitted from a planter's *shamba* at Voi towards the end of the year; 19 of these improved, 1 died, and the remaining 8 were still under treatment. Here, again, the patients were all up-country folk. An interesting fact was that their diet scale did not include rice, being almost wholly mealie meal."

In the Sierra Leone Medical Report for 1912, it was stated that in the gaol there were 32 cases of beriberi with 4 deaths, and that 20 cases remained in hospital at the end of the year. It was stated that "uncured" (husked) native rice was employed. In the Report for 1913, (p. 20), Dr. W. A. YOUNG, Medical Officer, Prisons, reports that during the year "seventeen more became infected and six deaths resulted."

PELLAGRA.

Dr. Alex KING, Medical Officer, 2nd District, Saint Lucia, gives the following opinion as to causation of pellagra *:—

"Cases of Pellagra cropped up from time to time, and it seems that this disease is becoming more prevalent. The incidence of pellagra does not fit in with the Simulium theory, and I believe that Dr. SAMBON has abandoned it. Nor does it with the damaged maize theory; in fact, in only one of the cases which have come under my notice was there any history of continuous consumption of corn meal; and, even then, there was no reason to suppose that the meal was in any way inferior or damaged."

*SAINT LUCIA.—Annual Report of the Medical Officer. 1913–14, p. 5.

After alluding to the work of Surgeon GOLDBERGER (U.S. Army), on the subject of dieting in this disease, he states :—

"It is certain that the class amongst which the disease occurs here subsist on a very monotonous diet, and that fresh meat is usually replaced by salt-fish. The hypothesis would also supply a reason for the occurrence of cases in gaol among those inmates who practically spend their lives there, as the gaol diet (though calculated to conform as closely as possible to standard diet) is certainly monotonous and does not contain a superabundance of fresh food."

SCURVY.

In a recent number of this *Bulletin* (Vol. 4, No. 8, page 447) will be found an allusion to the influence of cooking upon the anti-scorbutic powers of cabbage. The "Board for the Study of Tropical Diseases" of the United States Service (p. 125, Report of the Surgeon-General U.S. Army for 1914) state that their experiments with guinea-pigs (which are peculiarly susceptible to scurvy) "showed that canned cabbage was quite an efficient preventative and that boiling for one hour does not decrease the efficiency, as observed in guinea-pigs."

ANKYLOSTOMIASIS.

Examination of Subjects.

Assistant-Surgeon CONVERSE, U.S. Public Health Service, thus describes his method of conducting an anti-ankylostomiasis campaign :

"It may be of assistance to others to describe the machinery adopted when but one physician is in charge. The prospective patient was received by an office boy, who handed him a number in the order of his arrival. He passed on to a clerk, who filled out the portion of a clinical card concerning name, age, etc. This card was given to the patient. In the order of his arrival he reached the treatment room and went to the microscope. We were fortunate in obtaining as one of our inspectors a young Peruvian, José Cardenas, who had spent two years in the medical department of the Georgetown University and who took over this portion of the work. With frequent verifications of his work and personal examinations of all doubtful cases, diarrheic stools, and such other as were deemed necessary, the system worked well. The patient brought a match box or a bottle containing faeces, and the microscopical findings were noted on the card ; the patient then passed to us for the clinical history, physical examination, and treatment."

In Sierra Leone, Dr. YOUNG states that 41 per cent. of the prisoners in the Freetown jail are infested with ankylostomiasis.

Chief Medical Officer G. W. A. LYNCH, states that during the year 1913, in Fiji, "the Indians introduced were found to suffer to a larger extent than usual from this disease, having arrived in the Colony with the disease well marked, and in some cases so severe that it was necessary to reject them altogether." Dr. P. T. HARPER, Acting District Medical Officer, Navua, Fiji, shows that the mortality per mille of indentured Indians decreased annually from 1910 to 1913, inclusive, as follows—96·6, 48·1, 50·3, 29·3 per mille. He ascribes this reduction as undoubtedly due to an extensive sanitary campaign against ankylostomiasis.

Dr. Norman L. Leys, in charge Kilindini Hospital, East Africa, states :—"I feel certain that not less than a fifth of the people on the Island [Mombasa] are infected, and that much ill health, often undiagnosed, and sometimes not believed in, except by the patient, is to be attributed to this cause."

The Fly and Infantile Mortality.

The "Delhi boil" is quite an old acquaintance, but is likely to be overshadowed by the fame of the Delhi fly. Major A. W. Cook-Young, I.M.S.,* Health Officer of the Municipality, has pursued a steady campaign against flies in a city where their presence in vast quantities has hitherto been notorious. Recognising fly-borne enteritis as a great factor in infantile mortality, he shows, coincident with a reduction in the multitude of flies, the following decreased incidence in infantile mortality per mille of births :—

Months.	1912.	1913.
August	363 ..	333
September	409 ..	242
October	444 ..	222
November	415 ..	185

A step in an anti-fly campaign of considerable importance has been undertaken in the District of Lautoka, Fiji, on the plantations by Dr. E. G. Arnold† ; he states :—

"Separate fly-proof nurseries with concrete floors are in process of erection throughout the district and are completed and occupied on some estates. They constitute a great improvement on the old state of affairs and will probably do much to diminish the frequency of bowel disorders among the children."

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* Proc. of the 3rd All-India Sanitary Conference, held at Lucknow, Jan. 19–27, 1914. Vol. 2. (Suppl. to the Indian Jl. Med. Research). p. 146.

† Fiji. Annual Medical Report for 1913. p. 13.

SANITARY ORGANISATION.

The Elimination of the Epidemic Rate.

In his Annual Report for 1913, Dr. A. D. Milne, Principal Medical Officer, East Africa Protectorate, states :—" Were it possible to eliminate the disastrous effects of the epidemic diseases which so seriously affected the Protectorate during the year 1913, it could be said that a better standard of health was maintained than has been recorded." This has a family likeness to an interesting Government Review of the Report of the Sanitary Commissioner of the Punjab for 1912, in which it is stated :—

"These figures seem to show that the Punjab in a favourable year is healthier than several European countries, though it still falls a long way behind the most advanced. One of the problems before the province is the elimination of the epidemic. It is that which is the disturbing factor in our death-rates, and which may send up a rate of 26 in one year with a bound to nearly 50 in the next. But there is much to be done too in the general amelioration of the sanitary conditions of life. Measures undertaken with this end in view will not only reduce the frequency and the virulence of epidemics, but will also bring the death-rate for a healthy year much below the present figure of 26."

Seeing that in 1911 it was found that, in the intercensal period, the population of the Punjab had suffered two million deaths from plague, the officer drafting the Review had in his memory sound cause for urging sanitary reform.

As Dr. Milne holds that one of the most important features of the year's history in the East Africa Protectorate is the reinstitution of the office of the Deputy Principal Medical Officer, which had been abolished in 1908, and the creation of a Sanitary Division, it is apparent that he would agree with the opinion as to the necessity for an organisation which shall be capable of effecting a " general amelioration of the sanitary conditions of life " as the foundation for true progress. Indeed, it can only be by the possession of sound sanitary organisation and efficient sanitary works that it will ever be possible to quote vital statistics of the tropics that may rival those of advanced European countries, by rendering the elimination of epidemics an accomplished fact.

Finance and Sanitary Works.

The following extract from the " Review by the Government of Bengal of the Reports (1913) on the working of Municipalities of Bengal " exhibits a not infrequent trait in the treatment of finance by young public Bodies in the tropics :—

" In several municipalities the balances exceed the ordinary income, the explanation in most cases being that the municipalities are accumulating funds with which to carry out large schemes of water supply and drainage."

The Resolution of that Government also on the Reports of Commissioners of Divisions on the working of District Boards shows the

same tendency to accumulation of funds without, however, the added intention of devoting them to specific works :—

"A still greater advance was made in the expansion of Union Committees and the consolidation of the Unions already in existence. Eleven of these bodies introduced taxation for local sanitation. These enhanced powers were accompanied by substantial increase in the income of District Boards, and thus conditions were unusually favourable to progress. But the result of the year's work is somewhat disappointing, for despite the increase in their receipts the expenditure by District Boards actually declined, and the closing balances rose to a sum nearly equal to half the annual ordinary expenditure. This failure of local bodies to make full use of their resources in spite of their enhanced powers and greater freedom from control, is the most striking feature of the year's work, and the reduction of the heavy balances is a problem which deserves their most careful attention. Medical relief and sanitation received rather more attention than before, *but the expenditure on sanitary measures is wholly inadequate to the needs of the Presidency.*"*

In advising public bodies to undertake sanitary schemes, there will usually be met, during verbal discussion, three powerful opponents. They are powerful because plausible, and it behoves the sanitary adviser to beware of them. There is the man who, on a scheme being explained, will, with an air of complete conviction, startle all concerned by declaring it will demand for its execution impossible thousands. For his defeat, it is well to have ready an "approximate estimate," or ask him to give his figures and reasons. Then there is the careful man, who will point out that funds at disposal will only permit of a small expenditure annually from amounts not already ear-marked, and therefore instead of undertaking the complete scheme a portion might be accomplished year by year. It is of course unnecessary to suggest that there may be schemes where this is feasible, but, as a rule, this course represents very poor policy. For example, whilst in effecting town improvements there may be sound reasons to support the treating of areas at different periods, it is usually altogether bad in respect to groups of public buildings ; and the same may be said of its application to sewerage and water schemes. In regard to the two latter especially, errors in structure are likely to occur, as a result of constantly changing supervision, as well as actual waste of material. Nor are these the only obstructions to economical progress likely to be encountered. Officials are likely to succeed each other in bewildering succession, and the father of a scheme may have difficulty in recognising his offspring after it has been improved or mangled by various experts. In consequence, delay and often financial disaster result from dealing with schemes by halting execution.

But the most plausible opponent of hygienic advance is the man who asserts that a public body should not go into debt for sanitary works. He is ready with the ingenious argument that by putting aside each year a specified sum it will be possible after a certain period to undertake, without raising a loan, schemes of which the necessity is recognised. This policy will always find a number of supporters as it appeals to the innate dread of individuals, acquired in their private capacity, of "going into debt." This apparently accounts

* Italics not in the original.

for the undesirable condition to which the Government of Bengal refers in the above extract; the Municipalities and District Boards referred to doubtless have flattered themselves that in the possession of large unspent balances, ear-marked for important sanitary schemes, they are worthy of special commendation. Yet their action—or rather, want of it—must have meant the depriving of tax-payers of the present generation of many useful sanitary advances that the future generation may benefit; instead of adopting the sound principle of arranging by loans to spread financial strain for large works over a series of years, so as to render both present and future tax-payers liable to payment for benefits received.

A further method of false financial economy which young public bodies are liable to indulge in, is to starve the maintenance of completed works. Thus, the Bengal Government, in their Review, find it necessary to make the following remarks :—

"In reporting on the anti-malarial operations in North Barrackpore, Major Fry has remarked that the drains constructed there already show signs of neglect and lack of maintenance. It is essential that municipalities should realise that if drainage schemes are to be effective it is imperative that proper attention should be given to the drains after completion, and that the practice of undue retrenchment in the recurring cost of maintenance can only result in the waste of the capital expenditure."

Selection of Localities for Radical Anti-Malarial Works.

A policy which has numerous adherents is—before proceeding to undertake anti-malarial measures to explore huge areas of the country concerned and compile year by year facts as to the bionomics of mosquitoes, aided by speculations as to the accuracy of the vital statistics of the inhabitants. The net result may be that it is discovered, here, the chief malaria-bearing mosquito haunts domestic wells or, there, prefers pools of brackish to fresh water at disposal in neighbouring marshes. It is then possible to say, had anti-malaria works been undertaken against the marshes, the mosquito inhabitants of the well or the brackish water would have held sway with financially disastrous results. The argument is correct within the limits of saying that anti-malarial works should be undertaken in a special locality only after an examination of *local* conditions, and a verification of the necessity for action. For the rest, the leading feature in selection of localities should be the degree to which, being proved malarious, they are on the lines of traffic of the country, or are important sources of labour supply, and are therefore a danger to the country in general. Such a decision would also influence the question as to how far malaria stricken populations can demand financial aid from funds of a central government. To deal with the chief malarious centres of this character should be the first aim of the sanitarian, just as much as he would desire to focus efforts upon the control of carriers of other diseases.

Public works are often so situated that to introduce in the midst of labour camps a few malaria-stricken coolies may bring about epidemic outbreaks involving financial interests of great importance, and extensions of malarial fever from fleeing coolies in new areas of

country may occur before local control of mosquito propagation can be secured. An instance of danger of this nature is referred to by Dr. Radford, Senior Sanitary Officer, when in treating of malaria in Nairobi, East Africa, he states, in his Annual Report for 1913 :—" A large number of native labourers are infected on their way to and during their stay in Nairobi." What interruption of labour by malaria may imply has a fresh illustration in the *Report of the Bureau of Public Health, Philippine Islands,* for 1913, where it is stated :—" It is estimated that malarial fever in the Philippine Islands is responsible for at least 25,000 deaths per annum. Another 100,000 are ill from this disease, and are unable to perform work for varying periods of time."

Dwellings and Malaria.

During 1913, American troops were sent to occupy a position in the Panama Canal Zone without due anti-malarial measures having been first undertaken. An undesirable amount of malarial fever followed. Thereupon, Surgeon-General Gorgas furnished this opinion to the U.S. War Department* :—

" A commanding general should be as much shocked to find barracks at tropical posts unscreened as to find the buildings in the Dakotas unprovided with doors and windows, and quartermasters should as soon think of leaving a post in the tropics, which was to be occupied, without oil and larvicide as to leave a post in the Dakotas for the winter months without a supply of fuel."

Dr. Kennan, Senior Sanitary Officer, Sierra Leone, in his Report for 1913, gives an opinion as to public quarters in the tropics which touches a subject often forgotten, even where screening or other anti-malarial measures for protection have not been neglected. In discussing the danger of providing inferior " rest houses " for officers on travelling duty in proximity to native dwellings, he states :—" The provision of better lodging arrangements for those travelling on duty should be complementary to the improvement in their housing at new head quarters."

Camp Hygiene.

Domestic filters, unless their capacity for duty is ensured by conscientious treatment are, so far as microbic diseases are concerned, liable to be a snare and delusion; and hence it is an axiom that water for the household in the tropics should be boiled. Unfortunately, so great is the popular trust in filters that frequently persons boil and then filter water, instead of vice versa. But, when boiling is employed careful treatment is essential; in the first place, to secure that not mere heating is practised and, secondly, that contamination after boiling does not occur when the water has been cooled. The fact that such water is in an excellent position to favour an excess growth of organisms if contaminated has long been recognised. The Report of the Bureau of Health, Philippine Islands, for 1913 (p. 16) contains interesting evidence on this subject.

*United States Army.—Report of the Surgeon-General. 1914. p. 81.

The Bureau had required that water given to persons in restaurants, refreshment rooms, etc., should be sterilized by boiling. Thereafter, private persons considered, in certain instances, that they had suffered by being supplied with water that had not been sterilised. Hence, the necessity for ascertaining the extent of microbe increase in boiled water when subsequently cooled and left exposed. It was found that in 16 hours eight colonies per cc. were obtained and by 41 hours 74,183.

"When the water was loosely covered with a box . . . . the numbers of colonies were as follows :—Eighteen hours, 8 ; three days, 3,816 ; five days, 26,737 ; ten days, 20,925 ; twelve days, 6,754. From the foregoing experiments, it is shown that there is a progressive increase in the number of bacteria and then a diminution. The contamination is very much less in a covered can. It will therefore be apparent that a laboratory examination of water, for the presence of amoebae and pathogenic bacteria, that is presumed to have been boiled within forty-eight hours from the time that it is used, may serve as satisfactory evidence to present before a court."

A sound rule to follow, when on travelling duty in the tropics, is not only to make sure that drinking water has been boiled and subsequent contamination prevented but where feasible, to convey sufficient correctly protected boiled water from the last camp to the next, so as to give time for selection of a new water source at the place of arrival. This is a petty point but one that may influence the invaliding and mortality rate of officials.

SANITARY RULINGS.

Legalised Watered Milk.

In the Report on the working of the Rangoon Municipality for 1913–14, it is recorded that there has been a demand by that body for improved legislation as to milk supply. After pointing out that quite 80 per cent. of the total milk supply of the city is received from outside Municipal limits, the ends desired to be observed by increased legal powers are described as follows :—

"Briefly stated the scheme of the Committee is to take all reasonable measures to ensure that milk shall not be drawn from diseased cows, that the milk from the moment it is drawn to the time of its receipt at the depôt in Rangoon shall not be contaminated or watered, and that if retail dealers desire to sell watered milk they will be permitted under licence to do so, one of the conditions of the licence being that the milk shall be watered at the depôt only with pure water up to a prescribed limit. It must be recognised that in the interests of the poorer classes the sale of cheap but wholesome watered milk must be allowed, and it may be remarked here that the percentage of fat in local milk is greater than that of English cows, so that a fair amount of water may be added without bringing the percentage of fat below that allowed in England."

Of the necessity for action as to milk purity in Rangoon there can be no doubt and, irrespective of care as to the origin of the milk, which is now contemplated after many years' shelving of the question, the Municipal Committee has not asked for its protection from contamination without good cause. It is the custom for milk to be transported to the city or nearest railway station on the heads of coolies in open vessels on dusty roads; and to prevent waste during jolting it was common to find the vessel stuffed with leaves picked from the dust defiled roadside jungle. The passer-by could be accommodated with a drink of milk for cash which on receipt was thrown into the milk vessel, either as a safe receptacle or as a return by the bearer for value taken. But there seems less sound reason to support Municipal action in encouraging the sale of watered milk. Of course there is in England the precedent of the legalised sale of a mixture of chicory and coffee, but such a mixture might deprive a buyer of much coffee without more harm than the deprivation of a temporary stimulant. But to legalise watered milk tampers with nutrition. In defence of this scheme the Municipality points out that buffalo's milk, which is that chiefly sold, is so rich in fat that it will bear dilution, and that it is in the interests of the poor that this be allowed. The latter is the strong part of the argument, but it assumes ignorance on the part of the poor as to the quality of good buffalo milk (with which they and their forefathers must have been well acquainted) and their desire to pay for water that they may have fictitious milk. However, granting this much, it is evident that it would require an expensive analytical and executive staff to see that milk watered by the Municipality is not again watered by the vendor. If such doubt arose, there would ensue much swearing by the vendor as to actual care during the act of dilution by the Municipality, the chemical quality of their water as contrasted with the vendor's and the original constituents of the milk, etc. Moreover, the fact that the use of the cream separator is well known in Rangoon might result in milk being diluted that could bear no further diminution of its total fats.

There is also the possibility that although where caste is concerned (and the number of Indians in Rangoon is very large) there may be no objection to forgetting that water is added when purchasing from a "gowli," this might not be the case if Municipal employees added water as proposed.

Village Water Supplies.

The Madras Government has ruled that all villages possessed of more than 500 inhabitants shall possess at least one source of water supply officially recognised by the Sanitary Department as protected (*Report of the Sanitary Commissioner for Madras*, 1913.)

Irrigation and Malaria Prevention.

At the 3rd All India Sanitary Conference at Lucknow, a member of the Madras Legislative Council, the Hon. Rao Bahadur Ramachandra Rao gave it as his opinion, amongst other suggestions for the mitigating of existing evils incident to irrigation in certain areas in India, that Local Governments should rule that "in regard to pending and future projects of irrigation, the desirability of making provision for such initial expenditure on the sanitation in the area commanded by the project as may be found necessary, on account of changes consequent on the introduction of irrigation, be also considered." This practical suggestion if put into effect would doubtless prove not only saving of human life but of importance in the economics of the country.

East Africa Protectorate.

In the East Africa Protectorate, during 1913, the following, amongst many other, rulings were sanctioned :—

Leprosy.

Provision was made "for the isolation and detention of persons affected with leprosy."

Ways and Means.

"The Secretary of State authorised the utilisation of the proceeds of the auction of Crown lands for the purpose of constructing roads, communications and other development works."

Drainage of Premises.

In all subsequent leases from the Crown clauses were to be included compelling an owner to connect his premises, plot or area with any drainage scheme when completed.

Control of Building Sites.

At page 53 of the *East Africa Protectorate Annual Medical Report* for 1913, the Medical Officer of Health, Nairobi, gives proofs of the necessity for rulings that shall effectually prevent persons building or allowing others to build within their freehold premises without official sanction

He shows how, regardless of sanitary risks involved in overcrowding, owners "out for money" divide and sub-divide building site land bought at small cost, so as to secure disproportionate gains. He gives concrete instances of which the following is a sample :—

Owner A pays to Government Rs. 48 per annum for a plot of ground 100 by 20 feet. He divides the plot into two portions. These tenants again divide the area, so that ultimately on this small plot of ground buildings to the total value of Rs. 1,500 accommodating 25 persons are erected. The original owner A pays to Government Rs. 48, but receives Rs. 1,776. His sub-tenants B and D pay Rs. 996, but receive Rs. 984.

Inoculation with Haffkine's Vaccine.

The following are extracts from a Circular issued on the subject of protecting racial prejudices :—

"In all cases the husband or representative of the family should be informed of the intention to inoculate, and he should be present at the time such inoculation is performed. Under no circumstances should any inoculation be performed on any Asiatic or Arab woman unless a previous request from the parties concerned has been received and such request recorded in the office for reference.

Under no circumstances should any representative of the Medical Department enter any house for the purpose of inoculating Asiatic or Arab women, unless a specific request is presented which must state the reasons for such entry."

Sleeping Sickness.

By an order in Council, sleeping sickness has been added to the list of infectious diseases, under Section 32 of the Health Ordinance, "which gives power of arrest and compulsory detention in a contagious Disease Hospital."

SOUTHERN NIGERIA.

Prisoners' Diet.

In the Annual Medical Report for Southern Nigeria for 1913 (p. 19), it is stated that "Under the Prison Ordinance by Order in Council No. 12 of 1913 diet scales for European and native prisoners were published."

Surveillance "Permits."

The following Regulations have been made applicable to Southern Nigeria under the Infectious Diseases Ordinance of 1908 :—"Every person permitted to remain as aforesaid shall be given a permit as prescribed, signed by the Medical Officer."

Sanitary Zones.

The Acting Senior Sanitary Officer, Southern Nigeria, in the Annual Medical Report (p. 46) for 1913, states :—

"Soon after the arrival of the Governor-General in Southern Nigeria, His Excellency directed his attention to the solution of the segregation problem. . . . The view held, and it seems a thoroughly sound one, is—where Europeans or natives cannot be transferred to new sites outside

existing towns—to have a European Reservation delimited and a native free zone of a quarter of a mile in extent all round marked out on a town plan. This native-free zone may be inhabited at present by Europeans or natives, but gradually, as their leases run out, they will be permitted to obtain new leases of land in the specific areas to which they belong, and eventually the free zone will become uninhabited although offices, stores, etc. may be retained thereon."

Cholera Carriers.

The following is a copy of a Circular issued in the Philippine Islands, under the authority of the United States Public Health Service :—

" . . . It will be necessary hereafter, before bills of health can be issued, to present to this office a certificate for each steerage passenger embarking for Honolulu, or the United States, to the effect that his stools have been examined and found free from cholera organisms. This also applies to such steerage passengers as are bound for Honolulu and the United States, who go first to Hongkong or other Oriental ports to embark there." (*U.S. Public Health Service, Public Health Reports*, 1914, Nov. 6, p. 2,987.)

Cerebro-spinal Meningitis and Tuberculosis.

The Corporation of the City of Madras resolved that the above mentioned diseases "be declared to be dangerous diseases" under Section 3 (7) (*b*) of the Madras City Municipality Act, so that medical practitioners, hakims [Mahommedan practitioners] and vaidyans [Hindu practitioners] may be compelled to notify to the officers of the Corporation the occurrence of such diseases under Section 363 of the Act (*Administration Report of the Corporation of Madras* for 1912–13, p. 5).

DISPOSAL OF WASTE.

The Economical Value of Reclaimed Marshes.

At Coomassie the Medical Officer of Health reports that "Anopheline mosquitoes are numerous, especially from April to October. By means of open ditch drains the swamp to the west of the town and the east of the segregation area was taken in hand during 1913, and great improvement was effected; part of the swamp has been reclaimed and converted into a vegetable garden."

During 1913, the Corporation of the City of Madras made a profit of over Rs. 40,000 from the cultivation of grass on sewage farms. Certain of these farms are upon former salt-marshes, which have been filled and raised in level by deposit of municipal rubbish; but the larger area was a tract of nothing but sand—a recent deposit from the sea—which, without other soil admixture, under the stimulus of sewage, now yields magnificent crops of grass for fodder.

SANITARY WORKS.

Exclusion of Storm Water and Silt from Sewerage Systems.

Mr. Madeley, M.I.C.E., Special Engineer, Corporation of Madras, at the Third All India Sanitary Conference at Lucknow*, read a paper conveying matter of much utility on the above question. The subject has an importance in reference to the seasonal rains of the tropics and the habits of certain races, which do not present difficulties in European countries.

In regard to storm-water, there is the fact that in the tropics for many months in the year there may be no rainfall; hence the dry weather flow in a sewerage-system may be nothing but sewage, whilst in the rainy season the amount of storm-water, if included, may be enormous. These factors ordinarily dictate the necessity of separate systems for sewage and storm water, so that economy and efficient working be maintained. Under European conditions of household life there need be no difficulty in rigidly maintaining separate sewage and storm-water, or more or less combined systems. But the average non-European of the less wealthy classes in the tropics finds little space in the interior of houses for personal ablutions, and the washing of clothes and utensils; these and many other domestic matters being attended to in a small yard attached to the building. Even where land is of great value and the flat system of dwellings is pursued, a common yard for tenements is a feature when possible. The retention of cattle in these yards may complicate conditions where any but the water carriage system is employed; whilst faecal matter in bulk is otherwise dealt with, the washings of latrines are received with sullage. Hence, it would seem no less desirable in the tropics than in European countries to treat the first storm water flushes of house premises as sewage. If this be accepted, the sewerage system must be so designed, and, if a reasonable size of sewer is to be maintained, at convenient points storm-water overflows must be arranged. Nor are these the only complications met with; in some of these yards husks of grain, fragments of straw and, especially, sand, earth and ashes used for cleansing cooking utensils may mingle with a sewage rendered glutinous by the washings of boiled grain; so that the prevention of silting sewers has to be considered from other points than the mere maintenance of self-cleansing velocities in sewers, as held sufficient in Europe. It is to the solution of such difficulties that Mr. Madeley has set himself.

As Special Engineer for Madras City, where both the water supply and sewerage systems are under active revision, he has had excellent opportunities of studying the questions involved.

The writer confines his present remarks to Mr. Madeley's proposal for house connections, where the problem presents conditions markedly peculiar to the tropics. Mr. Madeley classifies the methods he suggests according to the nature of habitation to be treated. In the first class he would place houses of more or less European character, where it is possible to use the water carriage system, with the usual adjuncts

* Proc. 3rd All-India Sanit. Conference, held at Lucknow, Jan. 19–27, 1914, Vol. 1. p. 12 and Vol. 3 (Suppl. to Indian Jl. Med. Research), p. 194.

of water-closets, baths, lavatories and sinks. Here no unusual difficulties present themselves, and he therefore dismisses the subject without discussion. He then defines the other classes :—

"Second class drainage, retaining the existing open house drains. This system is used for the ordinary small houses of Madras, in which it would be most unwise to introduce underground drainage.

"Third class drainage for paracherries and collections of huts where each habitation cannot be provided with a separate sewer connection. These groups of dwellings are provided with sufficient [public] latrines for the inhabitants while a good class of open drain is constructed to remove sullage water from kitchens, etc."

Mr. Madeley's method of separating rainwater from sewage will be best understood by reproduction of his arrangement in a typical house of the second class (fig. 1)*. He thus describes the method :—

"The separation of rainwater from sewage in second class house drainage systems is effected by small brick or concrete curbs as shown in red . . . . These curbs divide the courtyards into washing places and rain water areas. Rain falling on the roofs pours off the eaves, and falling on the courtyards it is caused to flow at once into a 'U'-shaped storm-water drain by which it is conveyed to the street side drain. The soiled water from washing places, and that from household utensils, is directed by the curbs into the sewage drain coloured yellow. A good deal of washing is done on the verandahs surrounding the courtyards. A small open channel is therefore constructed round the margin of each courtyard and is protected from rainwater by the usual curb. It will be seen . . . . that this channel from the verandah empties into the sewage drain. By this means a practical working separation of rain water from sewage will be effected.

"In some cases the rain water and sewage drains are closed for short distances. For instance, the sewage drain is closed where it is found that rainwater will enter it, and the rainwater drain is closed wherever there is danger of sewage flowing into it. Governing these two principles is that of free access, and no drain or part of a drain should be allowed to be constructed that cannot be quickly examined and easily cleaned, when necessary. . . . . In some cases it has been found advisable to supplement the use of curbs with eaves, gutters and down pipes, but in most cases curbs are sufficient."

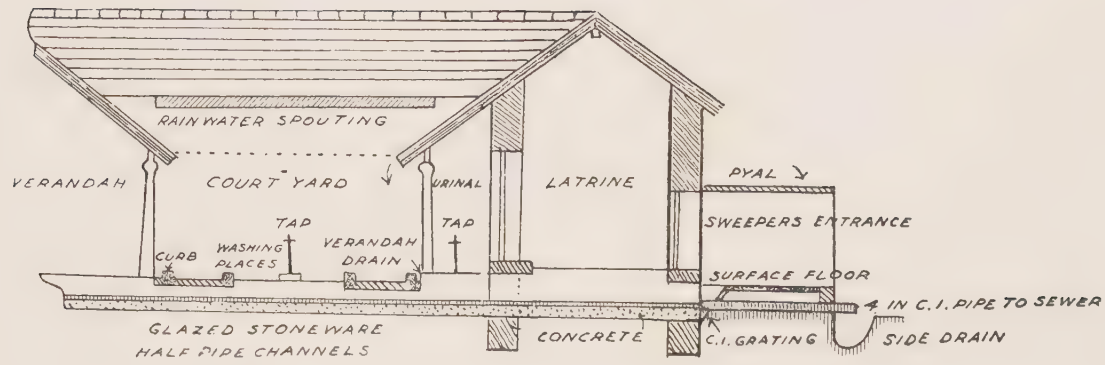
He states that the curbs exclude much silt, pot scourings, etc., but "for many years to come, special means for excluding silt will be required at house connections of the second and third classes." Hence, he has designed a special silt catcher. This "consists of a steel bucket fixed in a masonry pit on the house drain . . . . . The silt settles and accumulates at the bottom of the bucket, while the liquid flows over the rim on its way to the syphon trap" (fig. 2).

In treating third class houses, Mr. Madeley advocates the retention of open drains within the yards so as to receive household sullage from kitchens as well as rainwater, and for these to discharge into road-side drains protected by low curbs on the road side a little higher than the road level, so as to prevent debris from the road being washed into them. These drains then lead into silt traps at convenient positions at junctions with the usual types of sewers. These traps are designed so as to exclude a desired amount of storm water by means of (1) ordinary overflow weirs, (2) leaping weirs, (3) plate weirs, (4) the Madras storm water separator. These first three are adaptations of well-known principles. In the fourth, the ball valve method is brought into operation, and is used so as to throttle the exit of the trap.

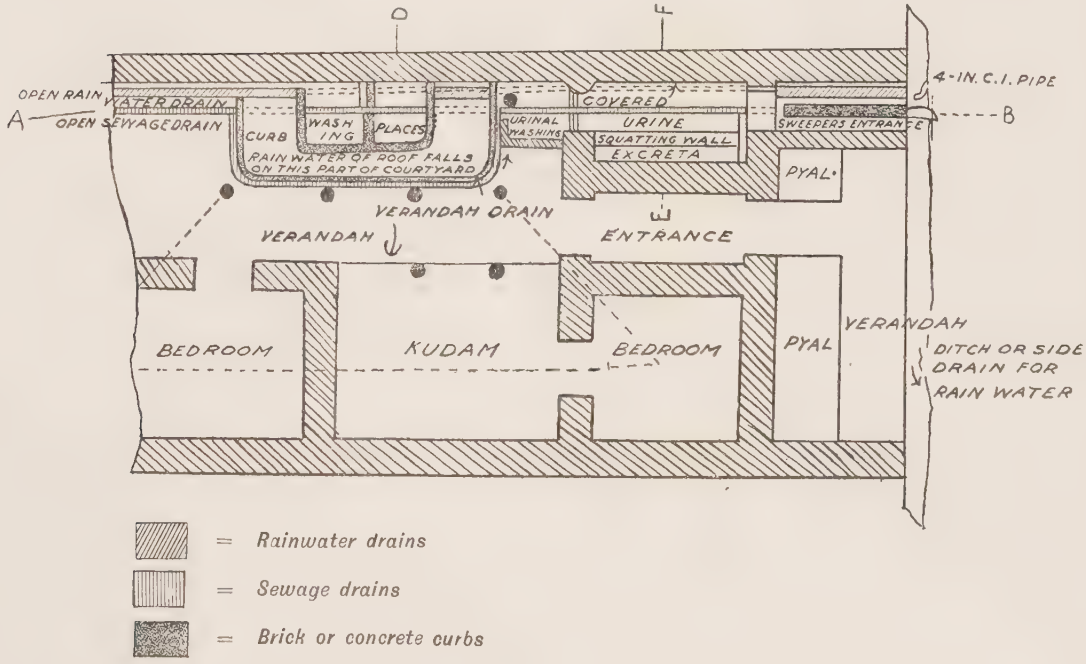
*The colours in the original are replaced by hatching.

Fig. 1.

A


RAINWATER SPOUTING
VERANDAH
COURT YARD
URINAL
LATRINE
PYAL
TAP
TAP
SWEEPERS ENTRANCE
CURB
WASHING PLACES
VERANDAH DRAIN
SURFACE FLOOR
4 IN C.I. PIPE TO SEWER
GLAZED STONEWARE HALF PIPE CHANNELS
CONCRETE
C.I. GRATING
SIDE DRAIN

B


D
F
OPEN RAIN WATER DRAIN
A
OPEN SEWAGE DRAIN
CURB
WASH ING PLACES
RAIN WATER OF ROOF FALLS ON THIS PART OF COURTYARD
URINAL WASHING
COVERED URINE
SQUATTING WALL EXCRETA
4-IN. C.I. PIPE
B
SWEEPERS ENTRANCE
PYAL
VERANDAH DRAIN
VERANDAH
E
ENTRANCE
BEDROOM
KUDAM
BEDROOM
PYAL
VERANDAH
DITCH OR SIDE DRAIN FOR RAIN WATER
= Rainwater drains
= Sewage drains
= Brick or concrete curbs

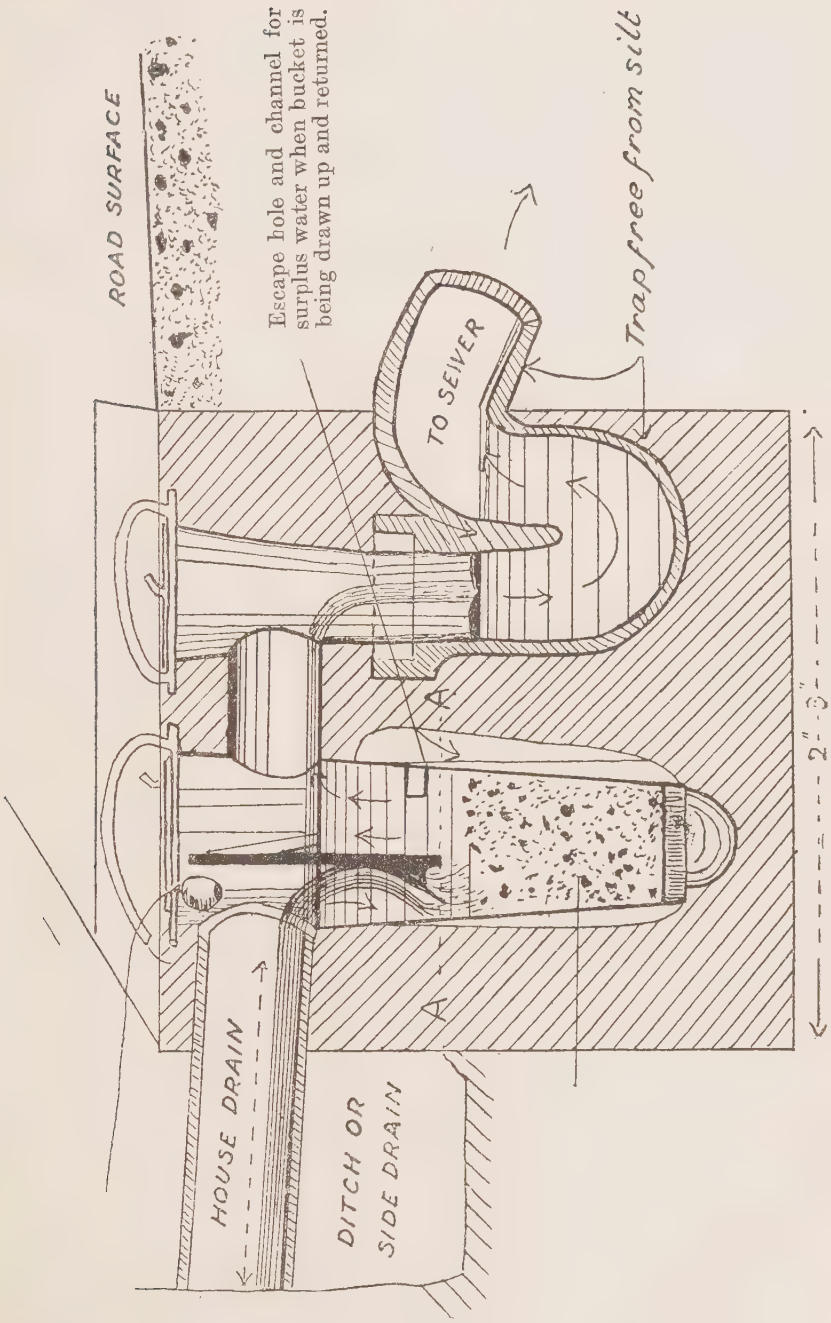

ROAD SURFACE
Escape hole and channel for surplus water when bucket is being drawn up and returned.
Trap free from silt
TO SEWER
2" - 3"
HOUSE DRAIN
DITCH OR SIDE DRAIN

FIG. 2.

In treating third class houses, therefore, Mr. Madeley receives both sullage and storm water together by private and public drains up to the sewer junctions, and these largely remove silt and reject surplus storm water by means of silt traps.

Mr. C. C. James, in his "Drainage Problem of the East" (Vol. 1, p. 3) thus states his concurrence in the necessity for the keeping of storm and sewage flow separate in the tropics :—

"The author's experience leads him to prefer carrying the subsoil and surface water in one drain, and all sewage and such rain water as falls on small courtyards and sweepers' passages or gullies in a separate sewer ; and in spite of its extra cost he believes this system to be generally the best suited to Eastern countries, in which the rainfall is confined to a few months in the year. No hard and fast rule for the adoption of any one system can, however, be laid down ; the ultimate verdict must rest upon the fullest consideration of local conditions."

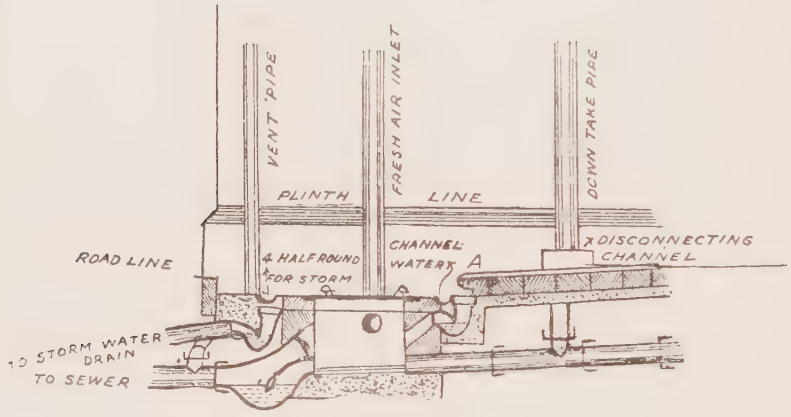


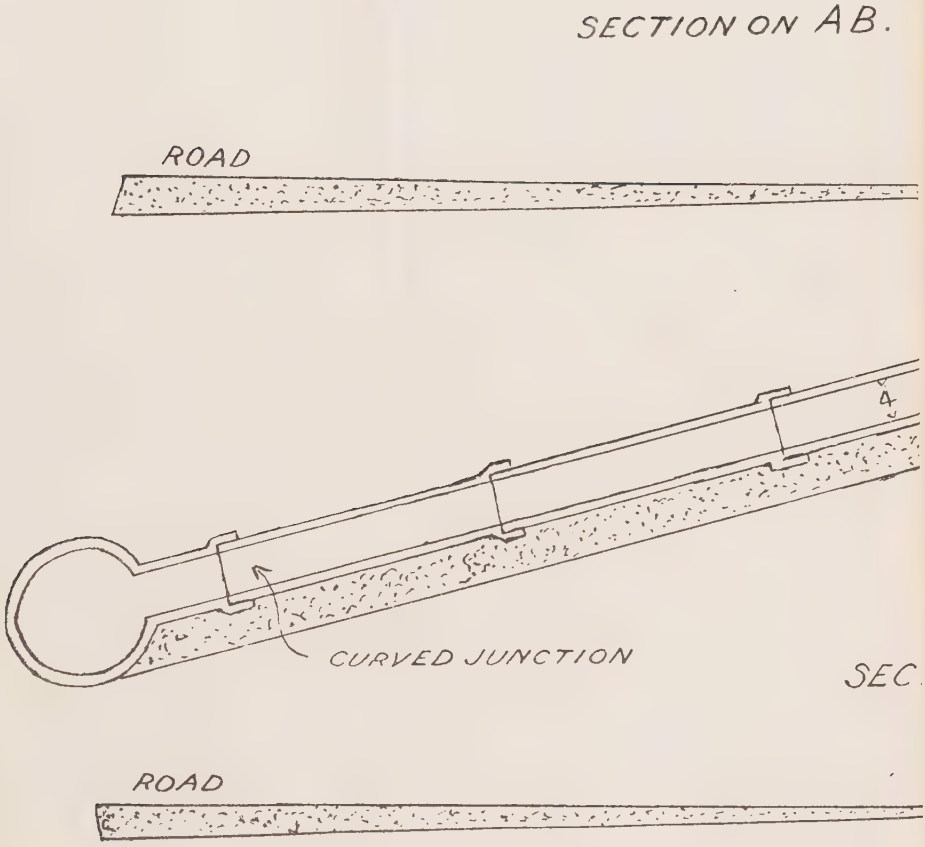
Fig. 3.

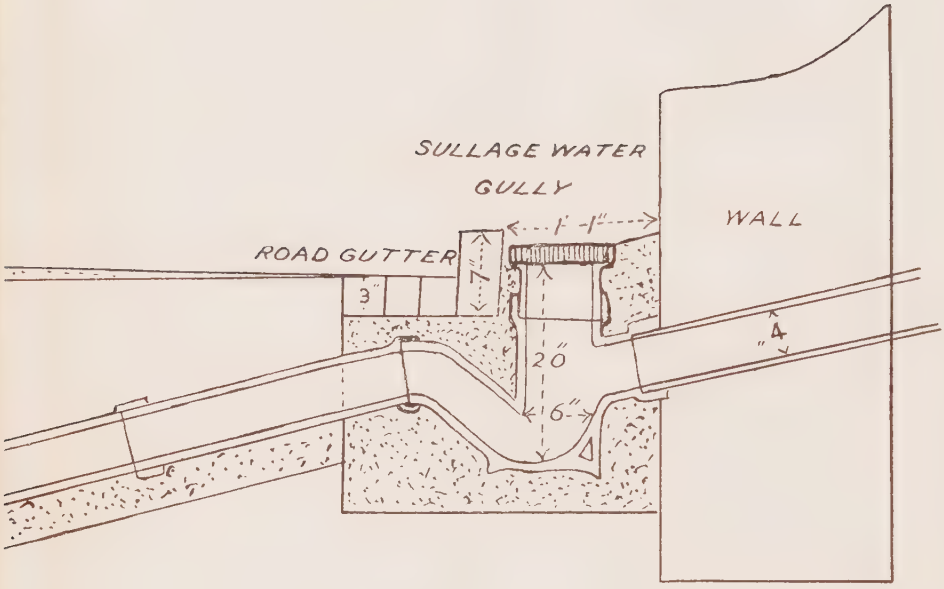
Above (fig. 3) is shown his mode of using the leaping weir (at A), so as to separate storm water and sewage within private precincts.

A method which the writer proposed in 1889 for a rural town may be found of use for what Mr. Madeley would classify as third-class dwellings, in accordance with Mr. James's policy of following no hard and fast rule*. The aim was to secure that all sewage and a *fixed amount* of storm water, such as would represent the first washings of yards and streets, be received in the same sewers (unaided by a second system for carrying storm water), with the reduction of the household additions of silt to a minimum, and the throwing upon the householder the onus of blockage and drainage of house drains ; whilst requiring the Local Authority to provide for each house an efficient ventilated trap between the house drain and public sewers immediately outside the premises, in a position rendering its inspection an easy matter. It is obvious that under tropical conditions of rainfall such a system, unless at intervals relieved of storm water, would degenerate into a "combined system" with expensive sewers of a size absurd in respect to the dry weather sewage flow ; or a modification of the method, by overflows into short lengths of special storm water pipes discharging contents in particular directions for selected areas, would become necessary—a method which has its merits in many circumstances.

*The result in practice cannot be stated although the method was formally approved by the Engineer authorities of the Government concerned ; the Local Authority of the period suffered from "want of funds."

Fig. 4B.




SULLAGE WATER
GULLY
1'-1"
WALL
ROAD GUTTER
3"
7"
20"
6"
4"

TION ON C D.

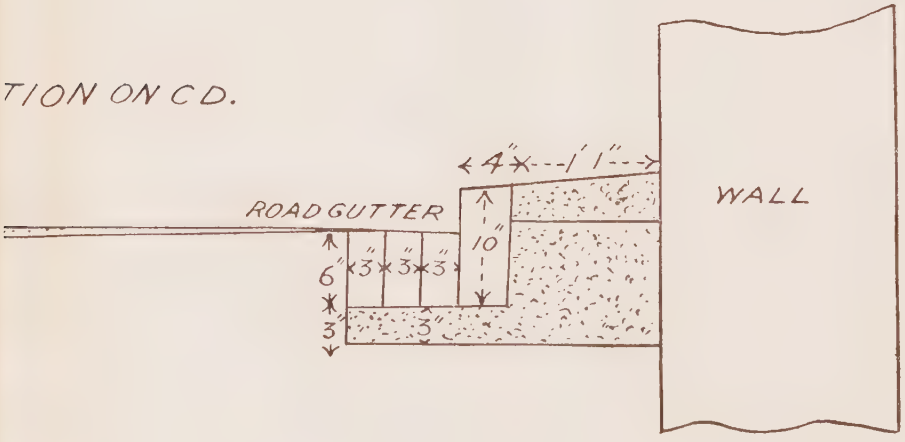
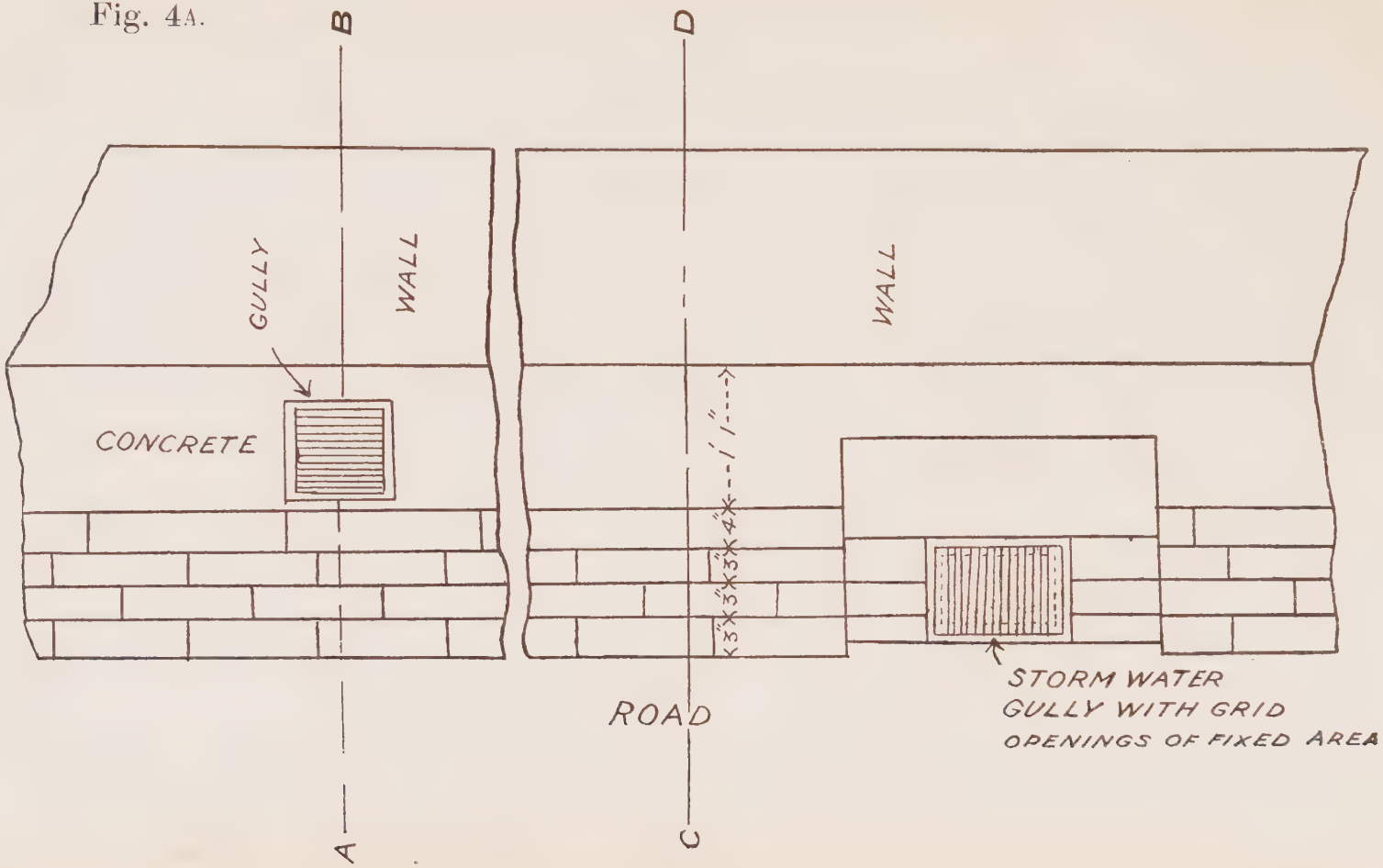

4"
1'-1"
WALL
ROAD GUTTER
10"
6"
3"
3"
3"
3"
3"

Fig. 4A.


B
D
GULLY
WALL
WALL
CONCRETE
3"×3"×4"
STORM WATER
GULLY WITH GRID
OPENINGS OF FIXED AREA
ROAD
A
C

Convenient points for overflow, where what would be highly diluted sewage could be safely disposed of, were in this case, however, obtainable. Ventilation of sewers was very completely arranged for by open-grid manholes and lamp-holes, with special regard to the fact that no ventilators could be afforded within third class premises. With these two points secured, the further details of separation of sewage and storm water were rendered possible.

In a town devoid of undrained depressions, and possessed of a fairly good gradient towards a natural drainage outlet, if removal of first storm water washings has been secured, there is no need to demand that rain water shall disappear from view as fast as it falls. So far as private yards of third class dwellings are concerned, ordinarily they are graded so as to direct flow towards the road on which they are built, and if not can be inexpensively so graded. This being so, it is rarely necessary to make any special rainwater drains within private precincts.

In the interests of exclusion of extraneous matter from yards and unlimited rainwater, it is undesirable to have any portion of the drain for receipt of sewage open. In the present day dread of mosquitoes, roof guttering or any other method of delaying discharge of rainwater from dwellings is best absent.

In areas where third class dwellings prevail, foot pavement not being likely to exist, the road drains usually are close to house walls.

Holding these various details in mind, the writer's method (fig. 4) will be understood. Along each street to be drained a concrete apron was run along the frontage of the houses, with the object of striving against penetration of damp and guiding rain water from frontage eaves direct, and indirectly from the rest of the houses, through their yards which are graded to the front by a simple slope, to the road gutters. The rain water was sent on its route to the sewer, where it had to pass through a storm water road gulley—provided with a silt trap—the grid of which, in each case, had openings allowing only the predetermined flow of first washings for the area concerned ; or, in other words, the area having been surveyed, and the rainfall thereon estimated (according to the fraction of the total intended to be received), the road gullies were placed at calculated intervals. The house drain was provided with a Buchan's trap open to the air within the concrete of the apron, immediately outside the houses served. Its elevation precluded its being flooded by the street drain storm water surplusage. At this point also, the curb of the road drain was sufficiently elevated to act as a guard to the trap from carelessly driven bullock carts. The underground house drain served the washing platform, which was provided with a common stable gulley trap with the usual dirt basket ; and as the platform was surrounded with curbs, the normal sullage flow was not added to by rainfall, unless by the platform area. The platform could of course have been protected by roofing in many cases. The separation of sewage and rain water within the premises was therefore reasonably complete. The trap outside the house was public property ; the platform gulley and the pipe were the property of the tenant, upon whom would rest the onus of allowing his gulley or his pipe to silt up and so cause obstruction ; whilst the public authority remained the guardian of the junction to the sewer, and was responsible for the cleansing of the house traps of allowable matter, which might escape the tenant's gulley. Under

this system, the writer believed it was possible, at little expense, to convert a scheme for receipt of sullage water and first storm water washings into a water carriage scheme of sewerage.

Laundries.

The Medical Officer of Health, Nairobi,* adverts as follows to the importance of laundries in their public health aspects :—

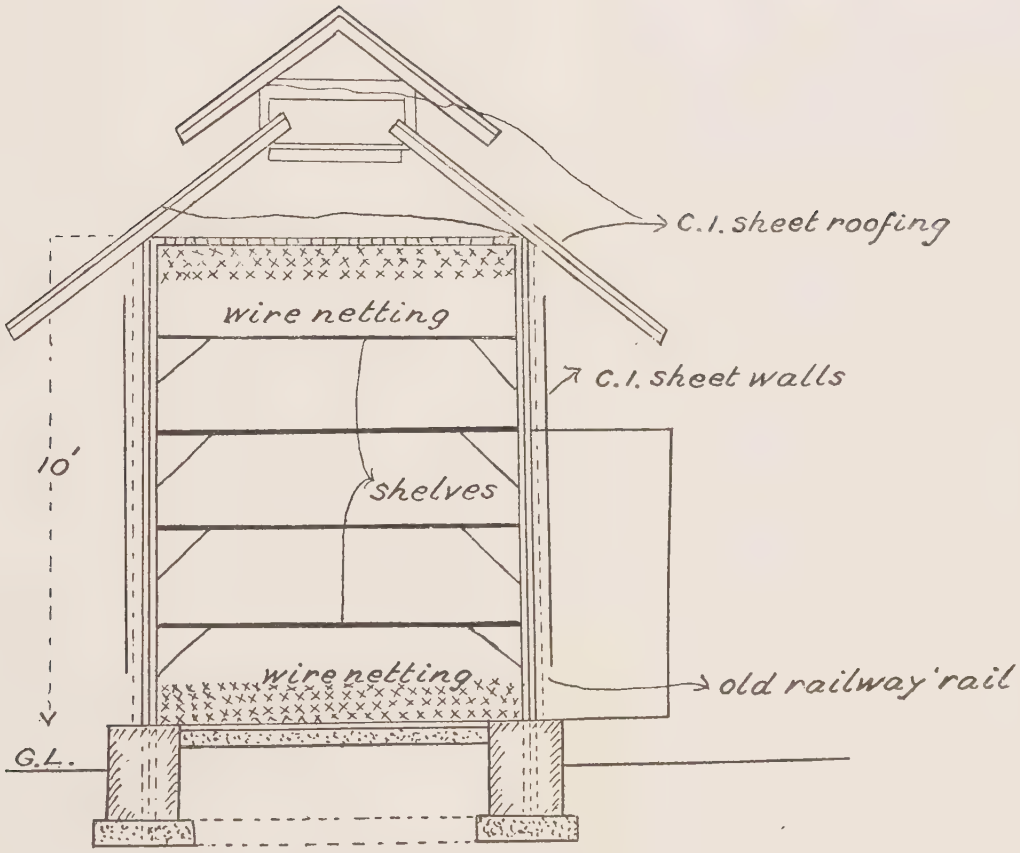
"Piped water at Nairobi derived from the town supply is used; this precaution represents practically the only safeguard to the public. The municipal quarters are fairly satisfactory, where 20 persons are each provided with one room for sleeping and living. No provision is made for boys, and the drainage is unsatisfactory. In other towns in the country the provision of public laundries is a matter that calls for consideration."

This description of existing conditions leaves much to the imagination; but it may perhaps be safely assumed, having regard to the emphasis upon the use of tap water being the *only* safeguard available, that the living rooms and those for storage of clean and soiled clothing are one and the same. Under such conditions, the employers of the washerman (the "dhobie" of India) are liable to share to some extent the family troubles of their employees. In certain parts of India, this is met by families engaging a permanent dhobie resident within their premises, but even this precaution does not get over possible complications; as, in the absence of careful supervision, the mingling of clothing of servants and especially surreptitious introduction of that of outsiders, to swell the income of the dhobie, become probable. Nor is it only the employer whose interest has to be considered. When Local Authorities fail to secure legal rulings to place the whole subject of laundries within their control, these may, through infection of washermen families by receipt of contaminated clothing, become foci for spread of epidemic diseases. For example, where ill-protected shallow wells furnished both the domestic and washing water supply, the writer has known an epidemic of cholera thus maintained betwen families and dhobies of localities wide apart. Moreover, as he has also found, the washerman is apt to find bed-sheets or table cloths make excellent coverings for cholera or small-pox corpses.

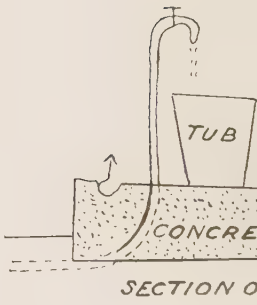
Hence it would seem essential that, as soon as any pretence at sanitary control is possible in a locality, the laundry question should be attacked. The writer considers this is best done by Local Authorities taking power to licence laundries and attached buildings and thus secure control, in each individual case, of water supply, method of washing, and storage of soiled and clean clothing. In using the power care must be taken to deal with washerman in classes, so as not to thrust upon them charges that would be recovered at the cost of the poorer employers and thus limit cleanliness; therefore in the lowest class, no charge should be made for the licence issued. Where the washerman cannot afford to bring his private premises up to the standard required, the use of cheap public wash-houses (without fees) will ordinarily solve the difficulty.

*East Africa Protectorate.—Annual Medical Report, 1913, p. 55.

Fig. 5B.



SECTION OF SOILED CLOTHES SHED

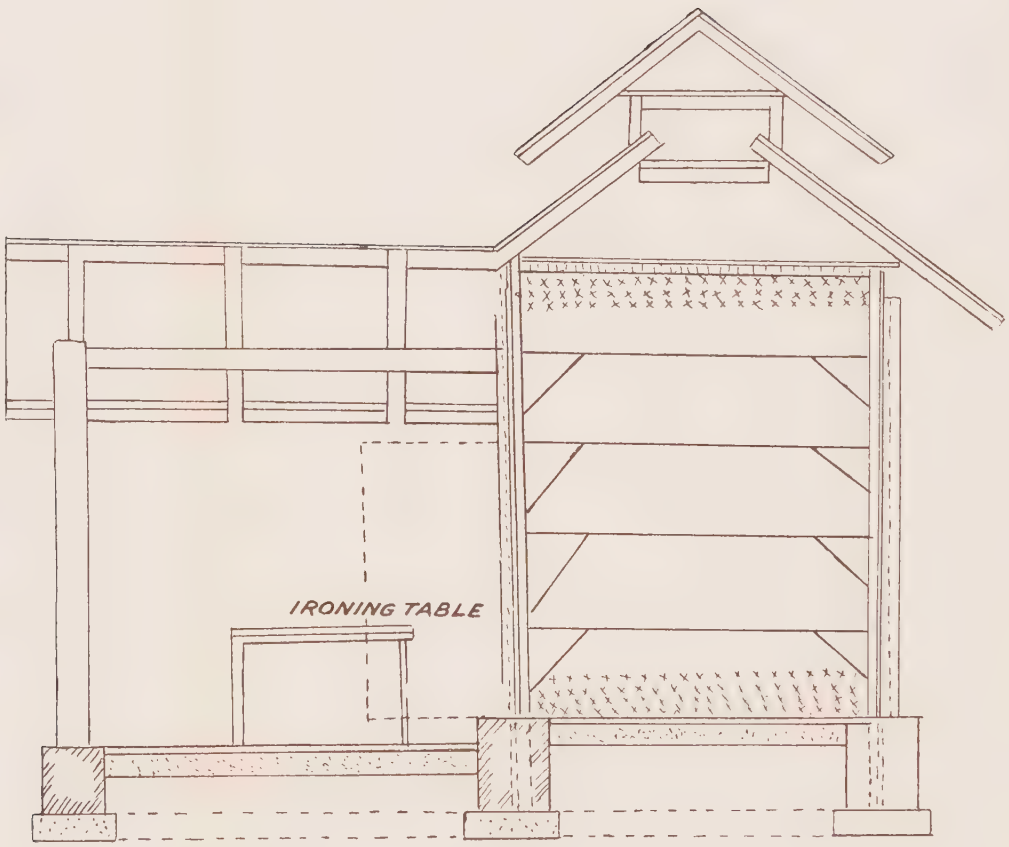


SECTION O

SHING STONE

ORTAR G.L.

G PLATFORM



SECTION OF CLEAN CLOTHES SHED

this system, the writer believed it was possible, at little expense, to convert a scheme for receipt of sullage water and first storm water washings into a water carriage scheme of sewerage.

Laundries.

The Medical Officer of Health, Nairobi,* adverts as follows to the importance of laundries in their public health aspects :—

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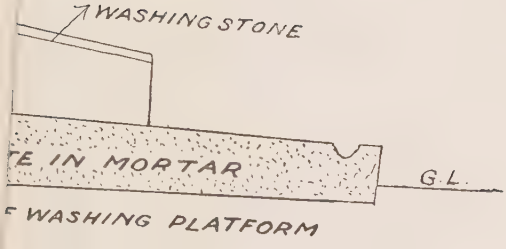

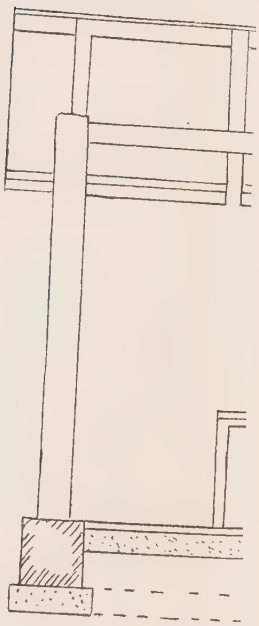

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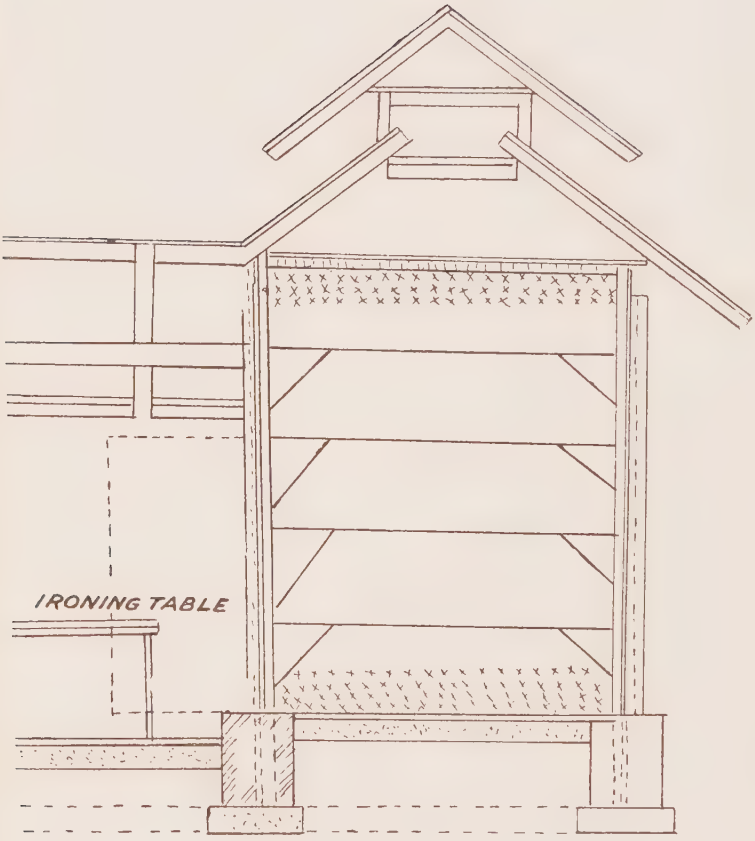
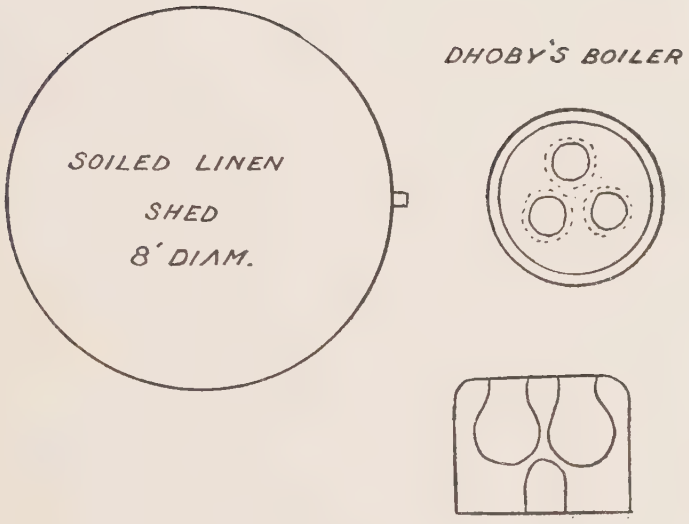


ECTION OF CLEAN CLOTHES SHED

Fig. 5A.



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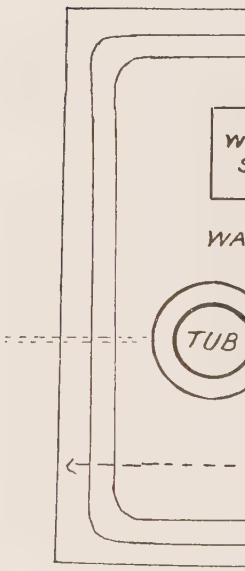
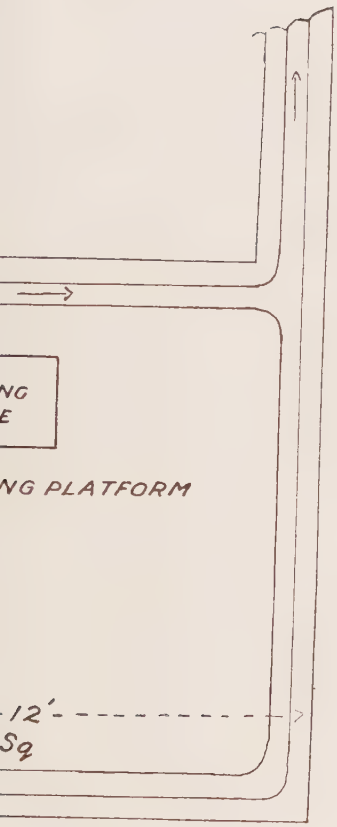
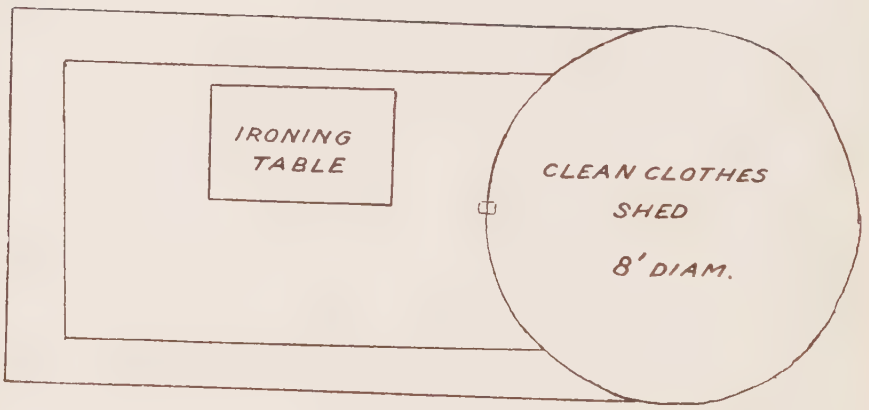


ft. = 1 inch.


NG
E
NG PLATFORM
12'
Sq


IRONING
TABLE
CLEAN CLOTHES
SHED
8' DIAM.

Appended is a plan (fig. 5) showing a type of cheap public laundry suggested by the writer in 1882 for the city of Madras. It contemplates the use of two circular sheds of smooth impervious material devoid of corners and provided with impervious shelves for receipt of clothing. The sheds are to be placed on raised platforms of masonry with a floor of concrete covered with smooth stone slabs having cut and cemented points, or with cement plaster. Each washerman is to be provided with two sheds opposite each other—one for the storage of soiled, the other for clean clothing, starching and ironing, etc. Between the two sheds is to be placed the washing platform. This is to be provided with water either from a public service or from an elevated cistern, to which it is pumped by bullocks or kerosine engine power from wells or other source. It will be noticed that the platform is provided with the usual washerman's stone for pounding clothing, and with an earthenware vessel for water into which clothing is dipped before pounding. The vessel being of moderate size compels frequent renewal from the tap, and it can at little cost be destroyed at intervals. The platform is to be extended in proportion to the number of washermen—each having his private portion. It has a slope which, whilst not so great as to inconvenience the washerman, conveys rapidly the foul water to a drain* for disposal by broad irrigation, filtration, etc. Boiling arrangements are supposed to be conducted in earthenware pots, in the usual type of Indian " boilers."

The sheds can of course be made of corrugated plain or galvanised sheets or reinforced concrete, with shelves of stone slabs, hard wood, or reinforced concrete. Where there is money to spare, the ideal would be sheds of reinforced concrete smooth cement plastered in the interior, or lined with white glazed bricks. The ventilation area above and below should be rat-proofed. The premises should be completely enclosed. In working this public laundry each washerman would provide his own padlocks for the two sheds; the keys to remain in his possession.

The type shown provides sheds of a small area and, in most localities, should represent a cheap investment. For a locality of any importance, the addition of drying sheds, bleaching grounds, tailor's room, steam-disinfecting machine, guard-house, office, conservancy arrangements, etc. would be desirable.

Makeshift Laundry.

When confronted with shortage of water for washing purposes, other arrangements being temporarily impossible, a " better than nothing " method (instead of allowing the tropical predilection for clothing being washed direct in a scanty pool of water) is to cause the washermen to put their pounding stones on the top of the best resemblance to an aerobic filter that can be made with local material on the banks (see page 460, diagram C, Sanitation No., this *Bulletin*, Nov. 8, 1914); even if it is nothing more elaborate than sand placed over graded gravel to a total depth of 3 to 5 feet, resting at its natural slope without enclosing walls. The used water would return to the

*A type used in India permits the washerman to stand in small reservoirs of water in which clean and foul water mingle.

pool from each man's "filter" in a condition that, if not bacterially sound, would be decidedly better than without this aid. Alum precipitation of the pool contents would be good final treatment.

Pot Wells.

In regard to improvements of water-supply in the Presidency Division of Bengal, the Government of Bengal*, after coming to the conclusion that the working of the Union Committees "was on the whole unsatisfactory," find some hope of their improvement in the statement that, in one of the Districts of Nadia, there has been "some attempt to improve the water supply by sinking earthenware pot wells and clearing jungle." This first step of the Union concerned, in respect to water supply, is certainly decidedly primitive; nevertheless, the Indian pot well, if slightly modified, has some merit. Normally, it consists of rings of unglazed earthenware without any bevelling or other arrangement for securing tight fitting. Except in the latter respect and in the absence of glaze, they have their prototypes in similar rings for wells, and man-holes for sewerage works, supplied by European stoneware manufacturers.

The writer considers these wells are (within the limits of the disability of being open) often capable of being used with sanitary efficiency, by the expedient of giving to the rings of earthenware a backing of puddled clay or concrete. If six inches of concrete be used for the upper three feet of the lining and both rings and concrete be continued above the surface, so as to form a parapet, and a platform with drain be added, a very fair grade of protection from surface and sub-soil contamination is secured.

If the native potters in the Gold Coast area are capable of making earthenware rings for pot wells, they would fulfil a useful function cheaply, under the circumstances described in the following extract from the Medical and Sanitary Report for 1913:—"In the Northern Territories the question of water supply is acute during the dry season, and large prices are asked for small quantities of water. Wells are dug but, being in sandy soil and their sides being unlined, naturally fall in during the short rainy season."

Pot wells make an excellent substitute for shallow excavations for substream water in sandy beds of rivers, and are frequently used in this way by Indians. The writer has used these wells for securing rough filtration of surface water of rivers, by making an excavation about ten feet square and five feet deep on a bank and filling this with gravel and sand or other available filtration media. A small channel or pipe should lead the water from the river to the top of the filter and, if the gradient of the river is sharp enough, an exit should be provided for the water at surface level at the distal end of the filter. If during the construction of this roughing filter a pot well be made at the centre, this will be filled by upward filtration and at least be of advantage in freeing the water of silt.

*Resolution reviewing the Reports on the working of the District Boards in Bengal. 1912–13.

Water Consumption in Indian Cities.

Mr. Streatfield, I.C.S., Chairman of the Municipal Board, Benares, at the 3rd All India Sanitary Conference* in his remarks upon water supply stated :—

> "So far as I am aware, no one has settled what is the legitimate consumption of an Indian City. It would be extremely interesting to hear the experience of any town in India, if there is one which gives a continuous supply with a reasonable pressure. I do not know if there is such a town. Certainly this question of water wastage is one of the biggest that has to be grappled with now by Indian Water Works."

If the question of waste, which may accompany the "reasonable pressure" (a point open to widely different opinion as to fire and power use) be put aside, and only legitimate domestic use be considered, it is possible to answer the query, with the caution that habits differ widely in various parts of India. In the Madras Presidency such an enquiry was conducted by the writer in 1896. The various domestic uses of water having been defined, with the aid of Medical and Sanitary Officers of Districts, trustworthy subordinates were deputed to undertake a complete measurement of the amount in use during a seven-day period by average cleanly families. He is satisfied that the water *consumed*, and not merely that drawn for possible use, was actually measured in all cases.

In Madras City, within an area where the public water supply wa continuous but had to be drawn from a standpipe ten yards distant it was found that the amount used was 13·20 gallons per head, of which only 2·20 gallons was from the public supply—the rest being from a shallow well within the yard. In this case, the observation was for ten days. In another family, where the public supply only was used, the amount was 14·61 gallons per head. In the Mufassal (up-country) districts the total average was 16·9 gallons per head, in all instances drawn from wells or tanks by hand and carried over varying distances. From this the writer concludes that in towns if water be used for municipal purposes, and moderate fires, trade purposes and waste be allowed for, the *minimum* for a small town composed largely of Hindus should be 25 gallons. Of course, against such an opinion it is always possible to quote instances of towns having water supplies for several years, where the consumption for all purposes per head of the population may not exceed 10 gallons ; but, unless it be shown that domestic wells have been closed and filth-laden tanks eschewed by the public, arguments based on facts so gathered are valueless. It may equally be added that in towns which retain their old contaminated sources of supply, whilst to some extent employing public water supplies, the inhabitants do not reap fifty per cent. of the life-saving value of the latter.

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*Proc. 3rd All-India Sanitary Conference held at Lucknow. Jan. 19-27, 1914. Vol. 5. Papers. (Suppl. to Indian Jl. Med. Research), p. 226.

VITAL STATISTICS.

Race and Malaria.

In September, 1914, on the Panama Canal, the admission rate to hospital and quarters for malaria was 64·30 for blacks, as compared with 144·25 for whites. For the year 1913, the "constantly sick" rate for all causes was for whites 31·68, coloured 11·76. The question of race effectiveness in this area, as judged by statistics, however, is complicated by the fact that "the whites receive pay for 24 days per year while sick from disease, while the blacks do not" (p. 6, *Report of the Department of Health, Panama Canal.* 1914. May).

Influence of Malaria on the Birth-Rate.

Major W. H. Kenrick, I.M.S.,* has shown how greatly malaria depresses the birth-rate in the Punjab, and that the "reduction begins nine months after the epidemic and reaches its height exactly nine months after the epidemic attains its maximum." He believes that by tracing the seasonal birth curve it is possible "for the course of an epidemic in a Province to be mapped out by a study of the birth statistics only." In contrast, he shows that in a healthy area in the Central Provinces births "are least in numbers during the early months of the year and greatest during the autumn months, the highest point being in October or November." He considers that the probable reason for this is that the early part of the year is the most healthy, and at the same time the period of the harvest—in other words, the time "when the physical and economic condition of the people" is best suited for fertilisation.

Major J. C. Robertson, C.I.E., Sanitary Commissioner with the Government of India, holds that, assuming the number of women liable to conceive remains the same in each month, the tendency of malaria prevalent from August to October would be "(1) to abort the conceptions of June and July, (2) to prevent conception from August to October, and (3) to cause premature delivery in the conceptions of the previous October, November and December." He further believes that "the similarity of contour of birth-rate and death-rate curves is the true one [and] is confirmed by the fact that, in places where there is marked double malaria prevalence yearly, there is also, as we should expect, a corresponding double rise in the birth-rate curves."

On the other hand, the following are the conclusions of a study of the birth and total death-rates by the Health Officer, City of Madras, as stated in his Annual Report for 1913 (page 27):—

"It seems to be the rule that August, September and October are the most productive months, as these show an increase of as much as 20–40 per cent. over the months of January and February in each year. The greatest number of conceptions therefore takes place during December, January and February, *i.e.*, the cold weather. A comparison with the death-rate shows that the month of maximum birth-rate coincides with the month of minimum death-rate."

*Lancet, January 25th, 1913, p. 233.

As to the seasonal death-rate, which is referred to in the preceding quotation, he shows, at p. 34 of the Report, that September affords 50 per cent. less deaths than December and that the largest amount of deaths occurred in that month. Of the total deaths in Madras, he calculated that 13·4 per cent. are due to malaria and adds in respect to the worst Divisions of the City (Tondiarpet) that as "the death-rate from malaria varies between 11·5 and 15·5 it may be better imagined than described what the morbidity rate must be."

Captain E. C. Hodgson, I.M.S., Special Malaria Officer for Madras City* gives the following definite statement :—"I wish also to strongly call attention to the fact that malaria appears to be shown to occur almost entirely during three months of the year, *i.e.*, from December to the end of February, *i.e.*, the coldest part of the year." Maximum malaria death-rates and conceptions therefore coincide in Madras City. Information gathered from the birth-rate cannot, therefore, be regarded as of so definite a nature as to permit of a malaria epidemic in so large an area as a province being "mapped out by a study of the birth statistics only." In at least the South of India, the birth-rate of Indians may be disturbed at intervals by the consummation of marriages temporarily deferred, in accordance with a belief in impending calamity as judged by Hindu cycles; and it may assume annually a sudden exacerbation owing to selection of periods which, by popular consent, have for hundreds of years been regarded as auspicious "marriage seasons." Not only customs of the people, but local conditions must also be taken into consideration. For example although, as shown by Major Kenrick, the only difference between a healthy and malarious tract may be physiographical features—the people being of the same race and habits—it would be necessary to ascertain whether these features do not determine the time, number and nature of harvests, which he regards as largely influencing the health and economic condition of the people, and therefore their fecundity. It being understood that first marriages are by the young and comparatively vigorous, this may, even in malarious tracts should there be a recognised marriage season, raise the rate to a maximum by excess conceptions within the first three months of marriage.

In the ten years average preceding 1895, in Districts in the Madras Presidency, the apex occurs in June in two districts, in July in ten, whilst August disputes precedence in four. In the malarious District of Cuddapah, the curve commences in July and reaches its apex in October, as well as in two other Districts. Major Kenrick's deductions, therefore, whilst doubtless quite correct for the Punjab, if applied without the modifying factors of local circumstances to other Provinces in India, might result in showing that the most markedly malarious Districts are healthy, because the highest point of the birth-rate curve is in October.

The tendency for a decrease of inhabitants to occur in malarious tracts is well acknowledged. Allowing for emigration in search of healthy localities, the fact remains that deaths often exceed births. All irrigated tracts are of course not malarious, but largely this is the

*Page 179 of the Administration Report of the Corporation of Madras for 1913.

case. Without such differentiation BAIRD SMITH* shows that whilst the result of irrigating an area is to increase the inhabitants by influx for labour—for which he quotes Indian Statistics—in Italy it has been found that "while the inhabitants of the un-irrigated provinces marry in greater number than in the irrigated ones, their marriages are also more prolific." Thus, in the irrigated districts, the average children per family were 4·87, whilst in the unirrigated there were 5·01. When the subject is narrowed by regarding results in admittedly malarious areas, there remains a difference of opinion as to whether the decrease of population occurs by diminution of the birth-rate or by great infantile mortality.

DEMPSTER (of splenic index fame) believed that impotence of the male following the debilitating action of malarial fever has to be taken into account. DYSON, a former Sanitary Commissioner for Bengal, in an official Report in 1895, thus gives his opinion from personal enquiries :—

"One of the gravest evils, and one which is particularly felt by the Hindus, is the impotency so commonly found in water-logged villages, which results from the deterioration of health produced by constant attacks of fever, and the presence of an enlarged spleen. The men in these villages acknowledge it, and beg for some remedy. As regards impotency in women, the subject is naturally a very delicate one, and any information on this point is very difficult to obtain. But if, however, the existence of sexual desire precludes the presence of impotency, then the women do not suffer in anything like the same degree as the men; for many were the complaints made in villages that, owing to the impotent conditions of the men, the women showed a decided tendency to lead loose lives."

The influence of lactation upon the catamenia is a matter that cannot well be without its influence in determining the birth-rate. The Indian custom is for mothers to breast-feed infants as long as any supply is forthcoming—a two-year period being common. The death of a child within this period is therefore quickly followed by pregnancy. Hence a high infantile death-rate is liable to be followed by a high birth-rate; but, in the presence of the depressing influence of malaria upon potential parents, the high infantile death-rate may not be followed by a high birth-rate, as it might be in a town where other causes than malaria affect infant mortality. In expressing this view, in the Annual Sanitary Report for the Madras Presidency, in 1893, the writer stated :—

"In Municipalities, Cuddapah returns the remarkably small birth-rate of 16·1 per mille. This result is probably due to the long recognised influence of continued exposure to malaria in diminishing the fecundity—the total death-rate of this town being 47·3 and that from malarial fever being 32·2 per mille. That this small birth-rate is due to this condition is further illustrated by the fact that, notwithstanding this town gives the highest rate (297·5 per mille of registered births) of infantile mortality in this Presidency, the usual factor of early cessation of lactation has obviously failed to raise the birth-rate. In contrast, I may state that in Madras the next most unhealthy town as to infant life (294 per mille of registered births) the birth-rate was 40·5 per mille, but here malaria is not [1893] the predominant cause of mortality."

*Italian Irrigation, p. 97, Vol. I.

The following note of an incomplete enquiry by the writer in 1887 gives some support to the opinion that decrease of population in malarious tracts is due both to decreased birth-rate and abnormal death-rate of children :—

Town.	Children born to each male in a married life extending from 1 to 20 years.	Children who lived over 3 years of every 100 born.	Remarks.
Pattikonda ..	4·91	79	Non-malarious.
Dhone	1·87	50	Malarious.
Velapuram	1·01	Not ascertained	Very malarious
Cumbum	2·19	61	Malarious.

The Influence of Food Scarcity upon the Birth-rate.

Major Clemesha, I.M.S.* records a decrease of 70,414 in the total number of births for the year 1913 in Bengal. This he ascribes to the high price of food grains during 1911–12 and 1913 reacting on fecundity. Increase of cost, in 1913, was favoured by destruction of standing crops owing to excessive rains in all the Districts of Bengal, except Chittagong.

An examination of the statistics for the general population afforded in this Report shows that the total death-rate for males in Bengal was 29·77 per mille in 1913 against 30·35 for 1912, and for females 28·96 against 29·17. Here, then, is an instance of continued high prices of food sufficient, as Major Clemesha states, to " inevitably lead to a general devitilisation of the poorer classes," which shows its influence by reduction of the birth-rate (the bulk attributable to conceptions that should have occurred in 1912), but fails to raise the death-rate in the face of continued high prices in 1913. It is fair to assume that the decline in the death-rate is, in part, accounted for by 19,117 less infantile deaths accompanying less births ; but a noteworthy feature is that whilst the saving of life of males on 23,365,225 was 0·58 per mille, on 22,117,852 females it amounted only to 0·21 per mille, a result that is the more striking as, side by side with it, is the fact that women ran less risks attending child birth.

In this connection, it will be interesting to ascertain whether the high prices of food grains short of the " scarcity rate " reported by the Sanitary Commissioner with the Government of Madras in his Annual Report for 1913 (p. 2) will show their influence in the vital statistics of 1914. He points out that rice, ragi, cholam, and cumbu during the year were sold at 33·8, 27·4, 33·1 and 28·6 per cent. above the average of the previous fifteen years. As the price was much the same as in 1912 and yet was followed in 1913 by a total of 1,288,618 births, or an increase of 43,153 births, the chances are the high prices have not been inimical to the poorer classes in the Madras Presidency. In that Presidency, there is no evidence that shortage of grain has been experienced ; whereas, in Bengal, this must have occurred consequent

*In his Report on Sanitation in Bengal for 1913 (p. 8).

upon destruction of crops. Nevertheless, the Sanitary Commissioner for Madras must have been correct in his remarks on the prices of grain when he states "there is positive evidence that living is becoming dearer nowadays." In the case of Bengal, the disaster to crops must have hit hard the agricultural classes; whereas in Madras the man of fixed income, more especially those in employment on pay settled during economic conditions which no longer exist, must have felt prices which (excluding the influence of war) are accompanying throughout India improving trade development and increasing price of labour, and with these must be reckoned the levelling influence of distant markets placed at disposal by railways. For example, shortage of grain in the Bombay Presidency in 1911 and 1912, which demanded relief measures by the Government of that area, probably implied an export from Madras of grain and an import of money.

Past philosophers pointed to the decreased birth-rate accompanying famines, as a response to a beneficent law of Nature; if a country were so ill adapted to sustain human life as to permit of famines, it was ordained that the matter be adjusted by a diminution of the population. But in proportion to the population which survives a famine, it has been long recognised that an increase of the birth-rate quickly results, on normal conditions of food supply being approached. The feeble, the old and the very young having been largely weeded out, those of both sexes who survive are by age and vitality specially fitted for reproduction. The Census of the Madras Presidency for the decade succeeding the famine of 1877 (which it was calculated by CORNISH had cost a shortage of population of 3 millions) showed the intercensal rate of increase to be 15·6 per mille, or about double that of the population under normal conditions. Following the famine of 1896–97 in that Presidency, in five affected districts exhibiting a decrease of the birth-rate in 1898 below the five years average prior to 1897, there occurred, in 1899, an increase of 5·9 above that average. A more recent illustration of the same condition is found in the Report of the Famine of 1911–12 in the Bombay Presidency; at page 10, it is stated:—

"Last but not least we must note that since the last famine [1899–00-01] the birth-rate has gone up enormously. Forty per cent. of the present population consists of children under 14. In 1901, children under 5 made up only 9·3 per cent. of the decreased population. Now children of the same age form 17·40 of the increased population."

FOOD SCARCITY AND MORTALITY OF THE SEXES.

The conditions described in the Sanitary Report for Bengal, as mentioned in the preceding Note, were therefore of a greater gravity than in Madras, and pressed upon particular classes, but in neither case did famine conditions arise.

The resulting diminution of births in Bengal and the small excess of mortality amongst women is of interest, in view of the difference of opinion exhibited by Mr. GAIT'S quotations from Reports by several officers dealing with the relative death-rates of men and women during famines.* In the famine of 1896 and 1897 in the Ceded Districts of

*Census of India, Vol. I, p. 221.

the Madras Presidency, the writer's "conclusions" in the Official Report on the subject were as follows:—

"If, therefore, it be conceded that in the affected districts there has been an increased death rate amongst women notwithstanding a diminished birth rate, accompanied by greater mortality amongst the very young (from one to five years of age), and amongst the aged (of and over fifty years of age), and that the rates of mortality of infants and from dysentery and diarrhoea have been abnormally high, it follows that the total loss of population stated to have occurred in paragraph 21 has been brought about by pressure of famine conditions upon the populations concerned."

On the subject of relative death rates of men and women, Mr. GAIT makes the following extract from the writer's Report just mentioned:—

"During the 1877 Famine, the late Surgeon-General CORNISH, then Sanitary Commissioner, found that deaths among men were far more numerous than amongst women. This he ascribes to the exhaustion following the aimless wandering of the men in search of employment that formed a special feature during the famine of that time. With, however, labour provided for the population, as in the present instance, the women have suffered disproportionately owing, it may be presumed, to the special tax upon their vitality in connection with their functions as mothers, and the extra strain involved in fulfilling domestic duties in addition to the day's work, of a nature most were not accustomed to*. The fact that the wife, according to Hindu etiquette, eats what the husband deigns to leave her also cannot be ignored."

These conclusions are from carefully compiled statistics and practical work in famines, and those of other observers affording a different opinion are equally so founded. Is it then possible to reconcile these views? The writer thinks that it is. Mr. GAIT writes (in a foot note) as follows: "The famine of 1896–97 in the Madras Presidency was not very severe and the excess mortality was slight." The estimate of this famine of 1896–97 as "slight" is correct if the resulting mortality be relied upon, but not if the conditions which had to be met were judged. For example, jowari (*Sorghum vulgare*), which is the staple grain of the Ceded Districts had reached in July, 1897, ten seers of 80 tolas per rupee, against a normal rate of 30 seers. No one would hesitate in pronouncing that *when due to failure of crops* such a rate meant to the Indian agriculturist not "slight" but severe conditions. The famine was, however, "slight" in mortality, for the reason that the lessons of the ghastly famine of 1877 in the Madras Presidency, of which CORNISH wrote as involving greater loss of males than females, had not been thrown away upon the Madras Government. The organisation of labour and relief was promptly directed towards preventing that breaking up of family life and wandering to which CORNISH correctly assigned the results upon the lives of males. Indeed, in the presence of pre-arranged organisation of the present day and ever increasing facilities of rail and road transport, *no future famine should produce any worse results in India than that of* 1896–97, *classed by Mr. Gait as "slight."* Major CLEMESHA's summary of the scarcity being sufficient to "threaten devitalisation of the people,"

*An ordinary day's work would imply several miles walk to a "famine work" carrying an infant to be suckled, a full task of metal breaking exposed to the sun, the walk back to the village or other place affording shelter, followed by the pounding, cleaning, grinding, and cooking of grain for the family.

followed by the decreased birth rate and the slightly (proportionately) greater death rate of females than males, shows that a condition was reached in 1913 which must have given him and the Government he served, sound cause for anxiety.

The divergent views are therefore reconcilable, if the different circumstances attending the statistics of famine conditions be taken into consideration and not solely the figures. Thus, speaking from an intimate knowledge of the famines of 1877 and 1896, the writer believes it would be a grave error to found a doctrine that a famine which did not show an increased mortality amongst males is "slight," in the sense that food scarcity must have been trivial. It may be assumed that advancing grades of scarcity will be marked by (1) a diminished birth rate, (2) diminished birth-rate with increased death-rate of women, children and the old, and (3) combined with the latter conditions, a disproportionately larger death-rate of men. When in the present day the last-named results occur, it may be accepted as a safe indication that relief measures have been too late, or that there existed a flaw in methods. In certain of the Reports of the famines of the seventies quoted by Mr. GAIT, the greater deaths of males than females are accounted for as a result of chivalry—*fidelis in arduis*. Without denying its existence, the writer suggests that "wandering in search of work," to which CORNISH ascribes the result in the great famine of 1877, involves the breaking up of families and of numerous factors peculiar to the life of the agricultural classes in India for which the chivalry doctrine makes no allowance.

INVALIDING AND DEATH-RATES.

The death rate amongst 740 European officials under the Gold Coast Government* was 8·10 per mille and amongst European non-officials 8·49. In a population of 796 European employees of merchant firms, the death-rate per mille was 8·7 and amongst mining companies 5·3; whereas, amongst 126 missionaries, the rate was 31·7. The respective invaliding rates were 5·74, 3·96, 1·62 per cent. The Principal Medical Officer makes the following remark on this subject :—

> "The death-rate for Trading and Mining Companies has declined, while that for Missionaries has increased, but the reverse is the case with the invaliding rate, it having increased for Trading and Mining Companies, but declined for Missionaries. I am afraid I can give no explanation of this latter, except that the same applies to the official figures."

The number of missionaries dealt with is of course small, the law of chances may have dealt hardly with them, and this alone may account for the grave rate of mortality. But, in larger figures, it may be regarded as possible to detect an increased mortality rate with a decreased invaliding rate. "Invaliding" is a preventive measure, and whilst in the interest of economy of both public and private funds laxity in advising it is to be deprecated, a well-balanced view of the subject whereby complete change from undesirable environments is secured, is both a life and money-saving measure. That a relation may exist

*(Medical and Sanitary Report for 1913, p. 14.)

between the mortality and the invaliding rate may well be granted; but seeing that individual discretion and idiosyncracies of medical men which influence the latter are usually the variable factors concerned, it would be impossible to deduce a law. For example, when British troops in India (1800–1856) died at the rate of 69 per mille, the invaliding rate was only 14 per mille but, in 1866–1869, when the death-rate was 29·28 (9 per mille being due to cholera), the invaliding rate was 41·5 per mille. Again, it is always possible in relation to mortality to detect a point at which a medical officer in charge of a disciplined body may have erred in reducing the admission rate ; the ambition to maintain a good effective list may swell the mortality rate.

Book Reviews.

Ghosh (Birenda Nath) [L.M.S.] & Das (Jahar Lal) [L.M.S.]. **A Treatise on Hygiene and Public Health with Special Reference to the Tropics.** With an Introduction by Colonel Kenneth Macleod [M.D., L.L.D., F.R.C.S.]—2nd edit. xvi + 394 pp. With 48 text figs. 1914. Calcutta : Hilton & Co. [Price 6*s*. net.]

As shown by the early demand for a second edition, this work has received a welcome in India where a " Sanitary awakening " has become evident, side by side with public funds rendered more accessible for its practical exhibition. Indeed, the fact that both authors are Indian graduates of the Calcutta University is of itself an earnest of that " awakening," in that the necessity for fostering it amongst their fellow countrymen has been recognised by them.

The authors state they have " in places much extended " the book. This was desirable ; as the commendable wish to practice brevity left room, in the first edition, for doubt on certain points. Much of this has been duly remedied, and the value of the work has thereby been greatly increased. There still remains, however, a little leaven of the former edition. For example, omission of allusion to the existence of intermediate stages in respect to two of the parasites mentioned in the following sentence, may lead to misapprehension, having regard to restriction of consideration to the " ova " in drinking water:—" *Entozoal Disease.* Diseases due to *Distoma hepaticum, Ascaris lumbricoides, Filaria sanguinis, Ankylostoma duodenale, Oxyuris vermicularis,* etc., may be contracted by drinking water containing the ova of these parasites." This is the sole reference throughout the book to parasites of great importance in the tropics.

Brevity of description as to origin of artesian wells also is such as to leave a very incomplete impression as to the necessary physical conditions. All the information available to the reader is :—" It often happens that the subterranean water finds its way downwards, until it passes under some more impervious rock where it accumulates. If a hole be made through the upper impervious bed down to the water-charged stratum below, the water will avail itself of this artificial channel and will rise or even gush out above the ground." Similarly, in describing the Liernur system of sewage the statement that the " propulsion (sic) of sewage is effected by means of a powerful air pump from a central station," requires modification.

The chapter on food deals with the respective merits of vegetarian and mixed diet, and incidentally contrasts the diets of Europeans with those of Indians. The authors have made statements on this subject which are sound in substance, and have the particular merit of having been approached devoid of bias.

W. G. K.

Sommerville (David), [B.A., M.Sc., M.D., M.R.C.P. (Lond.), D.P.H. (Camb.), F. C.S.] **Practical Sanitary Science. A Handbook for the Public Health Laboratory.**—2nd edit. viii + 328 pp. With 79 text figs. 1914. London: Baillière, Tindall & Cox, 8 Henrietta St., Covent Garden, W.C. [Price 10/6 net.]

This volume has been a trusted guide for several years to those studying in the Public Health Laboratories of King's College and elsewhere. When therefore it appears in a second edition, and the author gives the assurance that the arrangement has been altered and considerable matter has been added, the impression derived is that an already sound work has been strengthened by the addition of all available modern material. Perusal shows this to be well justified.

Books which aspire to treatment of the chemical and bacteriological details of hygiene in aid or confirmation of deductions from sanitary surveys, ordinarily deal with reasons for appeal to laboratory tests in a separate volume. Dr. Sommerville has, however, both in the first and second edition, adhered to the system, in respect to each subject treated, of first showing why and wherefore an appeal to chemistry and bacteriology is necessary. For instance, standards for drinking water are not immediately thrust upon the notice of the student, but he has, before undertaking tests, at once explained to him the overshadowing importance of a sanitary survey in disclosing potential danger points. This spirit prevails throughout the work; to applied science is rendered homage, its abstract counterfeit has no recognition.

W. G. K.

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The Director will be glad to receive early copies of works or reprints on Tropical Diseases for notice in the *Bulletin* and for the Library. To be addressed—Tropical Diseases Bureau, Imperial Institute, London, S.W.

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Reprints have been received from:—

DEEKS (Dr. W. E.); ERCOLE (Dr. N.); HAINES (Dr. E. F.); GILL (Captain C. A.); JAMES (Dr. W. M.); OHLER (Dr. W. R.); STRICKLAND (Dr. C.); TODD (Professor J. L.); VISENTINI (Dr. A.).

BOOKS RECEIVED.

STUDI DI MEDICINA TROPICALE, Vol. 1. Collezione di Publicazioni Scientifiche sull' Eritrea. Compiuto da Ufficiali Medici e Veterinari de R. Corpo di Truppe Coloniali dell' Eritrea.—xvi + 230 pp. With 75 text-figs., 1 map and 2 coloured plates. Publicato a Cura del Governo della Colonia Eritrea Asmara. 1914. L'Istituti Italiano d'Arti Grafiche di Bergamo. [Price L.8.]

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